THE

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THE

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1898

Edition

NOW READY.

H. ALABASTER, GATEHOUSE & CO.

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ELECTRICITY SUPPLY CONSIDERATIONS.

ANOTHER year has come and gone, and the counting of units generated, units sold, and units not accounted for, is no doubt proceeding apace with the enthusiasm one finds at the counting of the votes at election times. The time is fast approaching, if it has not actually arrived, when we shall be in possession of the returns of the many electricity works spread about the country. The older stations have reached a standard in low cost of production, as concerns coal, oil, &c., which it will be difficult, in many cases, to improve upon. In the more recent stations we expect a general improvement in these items, and we confidently expect to find a marked lowering in the case of the "two and three-year-olds."

That the supplying of electricity from a central station is a financial success is undisputed, and although some of the balances of the youngest concerns last year were on the wrong side, we shall no doubt find the majority of these, if not all, transferred to their proper side, where permanency is assured.

It is not our intention in this article to deal with the financial side of the question, but to give voice to some points which have occurred to us from time to time, and which, at this period, may not be uninteresting.

The first question which suggests itself is: What is the proper amount to put aside for depreciation? How long will it be before our engines, boilers, machines, &c., wear out? The answer may be that although the percentage put aside at present is small, it will be increased year by year as the machinery gets older, until ultimately things will be right. This may be approximately correct as regards the buildings, switch gear, and running plant, but who can tell us the life of the mains? A very large proportion of the capital expenditure is spent in mains. These are being continually added to; a short extension here and another there adds unconsciously as it were, until the aggregate amount at the year's end is enormous. We may select what appears to us the best main, and exercise great care in the handling and laying of the same, and by repeated tests made at regular intervals keep as watchful an eye upon this part of the installation as it is possible to do, and yet we cannot even guess how long it will be before they have to be taken up and replaced by others.

This is a most serious question. Because the mains are out of sight, they should not be out of mind.

Bare copper strips supported on porcelain insulators laid in stoneware conduits seem to have the best prospect of longevity. It is not always practicable to adopt this system, owing to the shallowness between the pavement and the cellar tops, also the presence of gas and water pipes which cross the pavements at varying depths render a capacious straight conduit an impossibility. This system has never been carried out in its entirety for these reasons, and also in consequence of the difficulties met with in crossing the roadways, when India-rubber cables drawn into cast-iron pipes are most generally resorted to.

Cheapness in cost and laying seems to be the principal

factor, at present, which governs the selection of a system of mains. Will the cable which costs so much per yard less than another, last as long? We know that steel armouring will not last for ever, neither will lead sheathing, nor the dielectric whatever it may be. The soil in which the cable is laid will materially affect its life. Instances of this kind are common, and heavy expenditure, quite unexpected, has been the result. Every precaution is taken by cable makers to supply mains which will last as long as possible, but can they guarantee even an approximate life, taking into consideration all the local circumstances? If not, why not?

We constantly have our moving machinery under observance, and we rectify before it can develop into a serious complaint any little irregularity that may be found. As we said before, we test our mains as often as practicable, for insulation leakage, but not for actual depreciation in the steel armouring, lead sheathing, or dielectric. We test our engines for efficiency with an engine indicator, but does it tell us when to put new brasses in the main bearings? We test our dynamos with suitable instruments for insulation, but do these instruments tell us when a new commutator is required?

It would be just as absurd to expect such information from these sources, as it is to assume that our mains are as good as when laid, because the insulation is high and the leakage low.

It would be well if directors of companies would carefully weigh these questions before declaring dividends, and allowing the depreciation to remain at "nil." Now is the time to prepare, and not wait till the calamity comes, and then be unprepared. Municipal authorities are not so likely to err in this respect, owing to the conditions under which their respective loans were granted. It would be well, however, for them to ask themselves this question—Are we allowing enough for depreciation on our mains? May the day be far distant when the mains of the country have to be replaced by others; but if no other item than the natural decay of all material had to be considered, it would only be a matter of time, and let us hope to see the word "nil" under the heading of depreciation removed from all the balance-sheets of all the electrical supply companies this year; if not all, at least those who cannot lay claim to being infants.

SUBSIDISED CABLE COMPANIES.

In the half-yearly report which the directors of the Cuba Submarine Telegraph Company have just issued to the shareholders, we notice a significant fact, indicating the policy of the Treasury and Colonial Office Departments of the Government in dealing with telegraph companies. The point to which we wish to draw attention is comprised in one of the paragraphs of the report, where it is said: "In consequence of the establishment of the new line between Bermuda and Jamaica, subsidised by the British Government on the basis of a charge of 3s. per word between the United Kingdom and Jamaica, the Cuba Company have been compelled to accept reduced rates, which will result in a considerable loss of income."

We have here a company—one of the pioneers—which doubtless had many a severe struggle to maintain, unaided, its existence in the early days, threatened, in its prosperity, by a competing line.

To ordinary competition every company is liable, unless they hold exclusive rights, and shareholders take their risks; but when, as it appears in this case, the Government comes forward and subsidises the new competitor, without giving an equal subsidy to the existing line, one would think that some injustice is being done. No one can contend that the new line is not an admirable one; it connects Halifax with Bermuda, Bermuda with Turk's Island, and Turk's Island with Jamaica—all British possessions. It may have been highly desirable, from an Imperial point of view, that such a line should be established, even if the private interests of certain British subjects should be damaged, on account of the necessity of it for the commonweal, and in that case we agree that these minor interests should be overridden. This has, apparently, been the view taken by our governors.

We sympathise with the shareholders of the Cuba Company, as, besides fighting a subsidised competitor, they will lose the receipts from the official traffic, which will surely pass by the all-British line, and there is also a lowering of rate to face which must, at least for a year or two, seriously affect their company's revenue.

May we not suggest that a partial remedy for their condition may be found in the Cuba Company approaching the British Government, not with the view of asking for complete compensation for damage sustained by the laying of the new Imperial cable, but with the object of obtaining from the Imperial Parliament monetary assistance equivalent to that granted to the new competitor. In this the company may succeed, as the British Government, representing the general community, may think it proper to grant some compensation for the damage this Government has caused to the company while acting in the public interest. The Cuba Company's case would appear all the stronger, in that the new line affords only a single means of communication, while the Cuba Company's route is duplicated throughout, and would appear to be necessary for the security of communication between the Home Government and the West Indian Colonies.

As precedents in electrical matters, where the Government has dealt with compensations, we have the purchase of the land telegraphs by the State, the arrangements with the Submarine Telegraph Company, and with the National Telephone Company. There are doubtless many other instances of compensations in the experience of the War Office, Admiralty, Colonial Office and Treasury, which resemble the case of the Cuba Submarine Company.

Tesla's Latest Advances in Vacuum Tube Lighting.

In a letter to the *Electrical Review*, N.Y., Tesla describes the results of some recent experiments he has made in vacuum tube lamps, and in their application to photography and other purposes. Along with the letter are published copies of photographs taken with Tesla's new vacuum. One is a portrait taken by the light of a single vacuum lamp at a distance of 5 feet with an exposure of five seconds. Another is a page of letterpress taken by a single vacuum tube at a distance of 4 feet with an exposure of two seconds. The photographs are not equal to sunlight photographs, but resemble more those taken with a single magnesium flash light, the shadows being very harsh, but the amount of detail is considerable. It is difficult to say from Tesla's letter in what his improvements exactly consist. He appears to have reduced the size of the vacuum tube, and thereby, as he says, considerably reduced the dissipation of energy from its surface. The illuminating power of the lamp with which the photographs were taken he estimates at 1,000 candles. The great superiority in efficiency of his system over earlier attempts at vacuum tube lighting he considers is principally due to the use of his improved apparatus for "producing economically harmonical electrical vibrations of extreme rapidity," referring, no doubt, to his oscillator recently described in the Electrical Review. Tesla promises soon to give further details of his system. The well known originality of nearly all Tesla's investigations leads us to look forward to the publication of the full description of his new system.

DEATH BY ELECTRICITY.

By W. S. HEDLEY, M.D.

It is not always so easy as might be supposed to kill an animal by electricity. The experiments of Brown-Séquard and D'Arsonval long ago* showed this, and many physiologists have since confirmed it. Kratter found that one short application of an alternating current at 1,500 volts sometimes did not kill either rabbits or guinea-pigs. Yet much lower voltages have often proved fatal to man. Indeed, it seems not improbable, as the present writer has elsewhere† stated, that all commercial forms of electric lighting currents, varying as they do from 80 volts upwards, may be dangerous to human life under certain conditions. It is, of course, true to say that, other things being equal, risk increases in direct proportion to the electromotive force; but absolute equality of "other conditions" can never be secured. The duration of the application, the nature of the contact, its superficial area and position, the condition of the skin, the periodicity of the current, the species of animal, its weight, age and perhaps even its state of health, are all factors in the result. That duration of contact has a most important bearing on the question, is nothing more than might be expected, for reasons both physical and physiological, and all experiment proves it. It has been shown‡ that currents, easily borne by an animal when momentarily applied, were fatal when the application was prolonged to 5—10 seconds. On the other hand, short but repeated applications of strong currents were almost invariably fatal. When other conditions are the same, the larger the area of contact, the greater the intensity of the current; but the less its density, and the latter can never be left out of consideration in dealing with physiological effects. The condition of the skin, with reference to moisture, or any breach in its continuity, is also a point of the first importance, inasmuch as the epidermis is the great insulator of the body. But, at the same time, it is to be remembered that the degree of skin injury is not always proportional to the gravity of the accident. Frequency of alternation must also be considered. It may be that fatal effects are in inverse ratio to the periodicity, although not perhaps according to a strictly "straight line law." Animals present differences in their resistance to the effects of electric currents according to their species, and even according to their individual peculiarities. Every animal seems in this respect to be a law only unto itself. It was found in the experiments already alluded to that rabbits often survived currents which proved fatal to dogs ten times bigger. In the original electrocution experiments in America, experiments were made upon a horse, three calves, and a number of dogs. The mean fatal current thus obtained was brought to bear upon the man to be executed, and the result proved a painful *fiasco*. Yet many experiences since then, some of them within recent months, have proved that a low as well as a high electromotive force may kill a man.

It is very generally admitted that in the case of animals killed by strong currents, there is a tolerable uniformity in the *post-mortem* appearances: (1) the latter in many respects resemble those seen after death by asphyxia (apnœa); that is to say, the left side of the heart is comparatively empty, whilst its right side and the larger veins near it are distended and filled with dark fluid blood. The absence of hæmoglobin from the blood is also a fact common to death by electricity and to death by apnœa. (2) The nervous system does not seem to present any very characteristic appearances, at least there is no "gross lesion" which can be said to be constantly present; but slight hæmorrhages in the walls of the fourth ventricle and in the meningeal coverings are not rare. Yet there may be many finer molecular changes in the nervous tissues of which present methods of investigation are not able to make us cognizant. (3) The points of penetration of the current are always evidenced by burns of various degrees. Less constantly the place of exit is similarly marked. These burns of entrance have considerable diagnostic value in cases when the cause of death may be in doubt. They may vary in severity from simple redness to complete destruction of the whole thickness of the skin; but, as already said, their severity has no close relationship with the gravity of the accident.

When a strong current is brought to bear upon a living animal, there is immediately a strong tetanic contraction of the entire striated muscular system; and on the circuit being broken there is often a deep inspiration, perhaps followed by an "expiratory cry." It is often this cry which first calls attention to the accident. In cases which are not fatal there is often loss of consciousness, which may be regarded as the clinical manifestation of the severe shock, or rather shaking, to which the whole central nervous system has been subjected. This is very different from what is surgically known as "shock." In the latter, the longer the condition of shock lasts the greater the danger. In electric accidents, danger of death *diminishes*, the longer the duration of loss of consciousness. It may be said that, if not immediately killed, the person usually recovers. This loss of consciousness soon disappears, perhaps, even, in a few minutes, but for days or weeks there may remain "head symptoms," such as vertigo and severe headache, or there may be palpitations or other such consequences. Neither sensory nor motor paralysis appear to be common.

Death, as the result of electricity, must occur in one of two ways—(1) by mechanical lesions of vital structures, or (2) by arrest of organic functions essential to life; that is to say, by arrest of respiration, heart action, or nutritive exchanges. It is in persons killed by lightning that the first-named mechanical or "disruptive" effects are usually seen. Industrial currents kill in the second way. But even here the difference is quantitative rather than qualitative. Most of the foregoing points have been put in evidence by Kratter and others, and, as already said, are generally accepted. The first class of cases need not be considered. It is self-evident that mechanical disintegration of vital parts must cause death. But, approaching the second class of cases, where death occurs by arrest of organic functions essential to life, the question broadens out, and it becomes necessary to inquire which of such functions is struck first. Where does death begin? What is the "mechanism" of death by electricity? At this point physiologists are no longer in accord.

Is it as D'Arsonval considers, that, acting on nervous centres, the electric current produces a variety of effects known as "inhibitory," viz., suspension of respiration, arrest of heart action, &c., and that it is the first of these that is primarily affected, inasmuch as cardiac action persists after the arrest of respiration. According to this view, there occurs, in fact, "a central paralysis of respiration, constituting a special form of asphyxia,"* due to exhaustion of the medulla and functional death of the ganglion cells. If this be correct, artificial respiration affords a hopeful means of restoring animation. This condition of suspended respiration must not be mistaken for death, and a *post-mortem* examination at once proceeded with. "Nécropsiés vivants" is the sensational term which, it may be remembered, was used in connection with the autopsy of the first electrocuted criminals in America.

Dr. Tatum, of New York, experimenting in 1890, came to the conclusion that strong currents kill by acting chiefly or entirely on the actual substance of the heart itself.

In 1895, Dr. L. Jones, having witnessed some experiments undertaken by Mr. Bokenham with reference to the amount of current required to kill anæsthetised cats, considered, from an inspection of the respiration and blood pressure tracings, that death began at the heart, and that the action of the current is "upon the heart muscle rather than upon any of its nervous mechanisms." In the *British Medical Journal* of January 15th, 1898, there appears a paper by Drs. Oliver and Bolam on the same subject, arriving at the same conclusion, and by the same methods, but not giving such details of amperage and voltage as would enable the experiments to be repeated by others.

Against these latter views it has been urged that were the heart's action suddenly arrested by the electric shock, there would not be the great disproportion in the amount of blood on the two sides of the heart that is present in death by electric shock. After sudden arrest of the heart's action, the amount of blood on the two sides of the heart is nearly equal.

* 1884.
† Electrical Review, January 28th, 1898.
‡ Kratter.

* Kratter.

Further, the heart theory rests chiefly on blood pressure tracings, and it is to be remembered that blood pressure is the result of other factors, in addition to the action of the heart.

This leads to another hypothesis. Dr. Bleile, of the Ohio State University, suggests, as the result of carefully conducted physiological experiments, that death by electric shock is entirely due to the fact that the current produces a contraction of the arteries through an influence on the nervous system; that is to say, through an effect on those nervous centres which control the diameter of the arteries, and that a constriction of the arteries so produced throws in such an impediment to the flow of blood as the heart is unable to overcome. This last-named hypothesis no doubt contains an important truth, recognising, as it does, the fact of peripheral obstruction as influencing blood pressure.

It is, however, contended* that the fatal obstruction is not in the systemic arterioles, but is owing to a constriction of the pulmonary arterioles, the latter being excited to contract by the entirely deoxygenised blood. Such a theory obviously falls into line with the *post-mortem* conditions, which, as has been seen, resemble those seen in apnœa.

It would, therefore, appear, not, perhaps, that each of these hypotheses are at hopeless variance, but that death from electricity may be accomplished by various physiological mechanisms. First, and perhaps oftenest, it may be by sudden arrest of respiration; at another time it may be brought about by sudden and primary stoppage of heart action; in either case, the result being not improbably due to physiological death of the centres of respiration or circulation from chemical and morphological changes therein, which present methods of observation do not enable us to recognise. Further, it is certain that these two centres act in unison, and it need not be surprising that the incidence of the damage done by the current may not always be distributed in the same way. But in accepting the foregoing, it is not to be overlooked that the view that fatal results from electric currents are due to damage inflicted within the actual structure of the heart itself is very influentially held, it has never been disproved, and may ultimately turn out to be a cause, if not *the* cause, of death from electricity. Thirdly, mechanical or disruptive lesions, such as tearing of blood-vessels and contusions of of the surface of the brain, are not limited exclusively to accidents by lightning, but have also been observed in a modified form in cases of death from industrial currents.

A short code of rules for guidance in such accidents has been ably formulated by the Electrical Review, and the present writer has dealt with the subject of "first aid in electric accidents" in an article under that name in the *Lancet*, August, 1894. It is sufficient to say that, notwithstanding the experiments of physiologists, and a growing experience of such cases, all that medical treatment can do is still to be summed up in the original formula of D'Arsonval, "Un foudroyé doit être traité comme un noyé;" in other words, by artificial respiration commenced early and continued long. But there is one further point with reference to this to which brief allusion may be made. It is known to physiologists that animals to whom nitrite of amyl has been administered are more difficult to kill by electric currents than are animals not under the influence of that drug. It acts by paralysing the walls of the small blood vessels, and so doing away with both arterial constriction and pulmonary obstruction. Now, without advocating that capsules of amyl nitrite should form part of the equipment of every "first-aider," it may be suggested that the use of this drug in cases such as drowning and electric shock would in safe hands prove a valuable adjunct to artificial respiration.

* *Lancet*, October, 1895.

THE ELECTRIC LIGHTING OF WASHINGTON.

The new plant of the United States Electric Lighting Company at Washington, D.C., is very fully described in detail in the *Electrical Review* of New York by Mr. Geo. H. Draper. On reading this excellent description of the new station supplanting the old, it is forcibly brought before us the rapid progress which electrical generation and distribution is making, when we find a comparatively recent works being replaced by a more modern plant and buildings.

It follows that the demand for electricity must also be increasing in proportion to warrant this enormous expense. A section of land has been secured which will allow of plant installed to supply ultimately a very large proportion of the lighting of the city.

The present plant can with ease be quadrupled when necessary, affording an output of 500,000 16-C.P. incandescent lamps or its equivalent in other forms of electrical application. To compare this capacity with that of our largest stations, we must reduce the figures to a common denomination. We count our capacity in 8-C.P. lamps, therefore the Washington station will have a capacity of no less than 1,000,000 of these lamps.

If the American proportion of plant capacity to lamps installed is the same as ours, then nearly 2,000,000 8-candle-power incandescent lamps or their equivalent can be connected to their supply mains before a further extension of their works becomes necessary.

There are two companies supplying electricity in the city, and this no doubt engenders healthy competition. Whether each company vies with the other to give a little extra voltage, and consequently a better light, we do not know; but this we do know, that the people of Washington, D.C., are reported to be complaining of the quality and price of the illuminating gas supplied to them. The street lighting of the national capital is also claimed to be inferior. Added to these facts the assertion that not 2 per cent. of the residences in Washington are lighted by electricity, we begin to realise why the United States Electric Lighting Company is making such elaborate preparations for a much more extensive supply.

Unfortunately, there are restrictions surrounding the extension of the subway system in Washington so severe as to be in some cases almost prohibitory. This is a serious drawback, for no matter how cheaply current may be generated, it cannot be sold to consumers at a low figure unless an economical means of distribution is available. Notwithstanding the retarding influence of these restrictions, the new plant referred to above, and which will soon be in operation, will enable current to be generated at reasonable and distributed at profitable rates.

Barriers of this kind cannot exist for ever, and with the opportunity of building or using sufficient subways for its purpose, the company should be able, in the near future, to remove any complaints as to service and prices.

In England we are striving to eliminate belt driving, for economic reasons, and it is therefore a little surprising to find that belt driving enters somewhat largely into the composition of the new plant under consideration.

The local circumstances may differ, yet where the size of the units are large, one generator, one engine, seems to us to be the rule.

In Washington, however, we find a combination which, on the face of it, seems economical, to say the least of it, although there are objections, which we will immediately point out.

Two large horizontal compound condensing engines in the basement operate a long length of shafting also in the basement, which in turn drives eight Brush 125-light multi-circuit arc dynamos by means of belting passing through the floor. Each of these large engines operates a direct-coupled low tension generator, either of which is capable of carrying the entire load. The arc machines may be thrown in or out of service as required by means of the shafting, by steel clutches, 5 feet in diameter. Although this arrangement provides for an economical operation of both the three-wire low tension and the arc light systems from one engine during the period of light load, we, in England, have learned our lesson, and profited thereby. Our opinion of this arrangement is that it savours too much of putting one's eggs all in one basket.

A slight accident to either dynamo, engine, or shafting would probably result in an entire dislocation of supply, and after all, the first consideration of the central station engineer should be continuity and regularity of supply, and economy of production and distribution afterwards.

In addition to the eight Brush arc lighting machines before mentioned, are two General Electric Company's alter-

nators, one A-70 1,040 volts, 125 cycle, one A-30 1,040 volt, 125 cycle, also driven by belting off the common shafting. A third alternator is to be run by a motor.

The interruption in supply is somewhat provided for by the employment of a large relay of storage batteries. The function of this battery is to help over the "peak" at time of heavy load. The battery comprises 150 cells, and has a capacity of 2,000 amperes on a side for three hours, and is so arranged that it can be connected with either the main bus bars or all feeders, and thus can always be used to best advantage. This battery is charged at times of lightest load in the small hours of the morning, and from 9 a.m. till 3 p.m.

The boilers are the well-known Babcock & Wilcox type, so largely used in our own stations, working at a pressure of 160 lbs. There is also a very large economiser, containing the feedwater, and affording upwards of 10,000 square feet of heating surface, thus heating the water from its ordinary temperature to the highest possible degree.

The switch-gear, one of the most important apparatus in a station, has received special attention. It extends the whole width of the engine room wall, operating the entire service of the company, comprising the low tension three-wire systems arc and alternating systems and the accumulators.

The whole of the apparatus is mounted on panels made of blue Rutland marble, highly finished, the instruments and appliances being the latest and finest instruments known to the electrical art.

We generally associate with America overhead distribution, but in Washington, at least, the underground system of mains is almost entirely used, very few overhead mains existing.

As previously mentioned, certain restrictions are in existence which greatly hinder the progress of electricity supply. No additional conduits can be laid, except by direct act of Congress; this does not, however, prohibit the repairing of the existing conduits. Owing to lack of experience, some of the original conduits, which were among the first to be laid in the country, are now in poor condition; moreover, the duct capacity is too small for the increased business. Owing to these defects, the company is at present engaged in rebuilding and modernising over 50 miles of conduit and cable system. Cost has been a second consideration in regard to efficiency. The conduits are simple in construction, and should prove efficient and durable.

What is known as the Lynch-Lake four-way glazed terra-cotta pipe is used, and also the camp glazed terra-cotta single duct, each having round holes 3 inches in diameter. This is laid at a depth of 30 inches from the top of the top duct to the surface of the street, on a base of 4 inches of Portland cement concrete, with 1 inch of the same material laid between each layer of conduit, and 4 inches of concrete is placed on the top and both sides. The joints are butt joints, and over each seam a strip of cotton is laid, which is then plastered over with Portland cement mortar before any concrete is put upon it. A mandril is used to ensure a perfectly clean joint before another length is laid. These joints are clean and perfectly water-tight. Large manholes, 5 feet square by 6 feet deep, fitted with cast-iron covers 5 feet × 5 feet, are built up in two or more pieces. All manholes are drained either to the nearest sewer or to the next manhole, and iron back water valves are used.

Throughout the whole plant, simplicity and durability of arrangement and design seems to have been aimed at, together with the best types of mechanical and electrical service to be had, and the prospects of the company now should be very bright, and we hope its progress will not long be hampered by irritating restrictions which seem to be unnecessary.

A DEPARTMENT OF ELECTRICITY FOR CHICAGO.

Judging from appearances and results, America has not in the past been noted for its restrictive legislation or protective supervision where the generation and distribution of electrical energy has been concerned, as the crowds of bare overhead conductors carrying high-tension currents, and the numerous fatal accidents thereby occasioned from time to time, bear witness. Chicago, however, appears to be waking up in this direction, and, according to the *Western Electrician*, the City Council propose creating a Municipal "Department of Electricity," with officers and staff consisting of: "A city electrician, an assistant city electrician, a superintendent of construction, a chief clerk, two book-keepers, two stenographers, one chief inspector, and nine assistant inspectors, and such other assistants and employés as the City Council may by ordinance establish." The creation of the department, duties and salaries of officials, regulations, fees, and penalties, are to be included in paragraphs 589 to 598, inclusive of Chapter XXV. of the "Revised Code of Chicago, 1897."

Paragraph 589 embodies the name of the proposed department and enumerates the staff.

Paragraph 590 creates the office of city electrician, states that he shall be a practical and skilled electrician, shall not engage in any other business, shall be appointed by the Mayor, and shall hold his office for two years. So far, good.

Paragraph 591 provides that the said city electrician, before taking office, shall execute a bond to the City of Chicago, with approved sureties (number not mentioned) in the sum of $20,000! "conditioned for the faithful performance of the duties of his office." As shown in the next paragraph, the salary is to be $4,000, the bond being equal to five years' salary! Evidently the Council anticipate a heavy revenue to the department from fees and penalties, and it is not a very cheerful prospect for the producers and consumers of electrical energy. We presume the bond is intended to cover possible defalcations as negligence or other similar offences could surely be adequately met by requiring his resignation.

Paragraph 592 deals with powers, subordinate officers' bonds, and salary. The duties of city electrician include "the management and control of the fire alarm, telegraph, and police telephone system, of all municipal electric lighting, of the inspection of all electrical wiring within the City limits, both inside of buildings and above, beneath, and upon the surface of the streets, and of all electrical matters in which the city is interested." Salary, as stated above, $4,000 per annum.

Paragraph 593.—Assistant city electrician, qualifications, duty, salary. The assistant to be capable of taking the duties of his chief in his absence. Salary, $3,250 per annum.

Paragraph 594.—Superintendent of construction, duty, &c. To put in new circuits and instal all new work of the city, under the chief. Salary, $1,800 per annum.

Paragraph 595.—Other officers, powers, duties, salaries. All other officers with their powers, duties, and salaries engaged and fixed by the city electrician.

Paragraph 596 provides that "no electric current shall be used for illumination, decoration power or heating, except as hereinafter provided."

Paragraph 597 requires that "all persons, firms, or corporations," desiring to use electric currents for purposes set out in paragraph 596, shall, before commencing any electrical construction whatever, "either installing new electrical apparatus, *or repairing apparatus already in use*" (italics are ours), "file an application for a permit therefore in the office of the city electrician," describing in detail the work to be done, and "upon receipt of which application, if found proper, such permit shall be given."

While reasonable supervision of wiring and other work on consumers' premises is proper and necessary, both in the interests of consumer and undertaker, we cannot help thinking that this is carrying supervision to the point of absurdity, if not prohibition. As the paragraph reads, and in the absence of further explanation, the unfortunate consumer has to be deprived of his light, power, or heat for hours, or it may be days, if the city electrician chooses to be obstinate, because, forsooth, a switch goes wrong, or some trivial matter, which may be classed as "repairs," requires doing. How, in the name of common sense, can repairs to "apparatus already in use" concern the City Council?

But there is more to follow:—

Paragraph 598 empowers the city electrician, and it becomes his duty, to inspect installations both before and after its completion, and may remove laths, plaster, boards and partitions, in order to inspect current carrying conductors; should he find that the work has been done in

accordance with the rules and requirements of the fire department, he shall issue a certificate—after receiving a fee—and the use of the current is unlawful until such fee is paid and certificate given. He may, however, issue a temporary permit before completion.

Paragraph 598A.—"A preliminary certificate may be issued by the city electrician in the case of completed installation, but upon which no current will be used in the immediate future." This certificate is to state that, at the time of inspection, the work was in order, and the fee shall be one-half the regular rates; before current is put on, another inspection is required, and, if still in order, the remainder of the fee is to be paid and final certificate given. The object of the preliminary certificate is not apparent, unless it is to fill up the time of the officials, as no current can be laid on until a further inspection and certificate is granted; and it is no consolation to the unfortunate householder, who wants the current, to know that three months ago his wiring was in perfect order, when a "dead earth," or other defect, prevents his being connected.

Paragraph 598B.—"The city electrician is hereby empowered to inspect or re-inspect all overhead, underground, and interior wires and apparatus conducting electric current for light, heat, or power," and if found unsafe to either life or property he can order them to be put right within 48 hours; failing which, a penalty of $10 may be imposed for each and every day they continue in an unsafe condition.

Paragraph 596C provides that all poles and manhole covers, now in existence or hereafter fixed, shall be stamped with the owner's name, and all services shall be labelled with the owner's name, and such a full description of the conductors as shall meet with the approval of the said city electrician.

Paragraph 598D prescribes the fees for permits and certificates as follows:

For each arc light	$1.00
For each 16-C.P. incandescent or equivalent ...	.10
For each E.H.P. of 746 watts used for power or other purpose than above	1.00
Minimum charge for inspection	1.00
Inspection of temporary installations, show windows, exhibitions, &c., at the rate, per hour, of	.50
For re-inspections, half the above fees.	

Paragraph 598E requires the city electrician to issue a yearly report, giving a full and accurate account of all inspections made and moneys received!

Paragraph 598F.—No alterations to be made to any installation without the previous sanction of the city electrician.

Paragraph 598G.—Any violation of these provisions entails a penalty of not less than $50 nor more than $100, and a further penalty of $10 per day as long as it continues. The city electrician may also order and compel the cutting off of the supply until the provisions are fully complied with.

Against reasonable supervision on the part of the local authority of all work affecting the public safety, particularly that executed and maintained by private enterprise, we have nothing to say, indeed, it is necessary and right, but when it comes to the infliction of corporation inspectors into private premises we draw the line.

Imagine what this means. A private citizen requires or desires the current for lighting his dwelling house. He is generally perfectly ignorant of all rules and regulations, and relies upon his wiring contractor (poor man) to do all that is needful. Such contractor, if unscrupulous, and we presume that even in America there may be some, does everything he can to evade inspection. The city electrician gets to know, and a $50 fine is the result. Suppose, however, that the contractor gives the required notice, and the city electrician cannot immediately attend, or does not deem it necessary, the work proceeds. The Fire Insurance Company require their rules to be obeyed; the Supply Company also has rules and inspectors. The fire department of the city has rules, and lastly comes the city electrician, whose ideas of good work may far transcend those of all the others. At his orders down comes lath and plaster, partitions, or other obstructions, to enable him to inspect, and then it may be condemned, and have to be re-done; but if passed, a fee of 10 cents per lamp is demanded. Again, the city electrician's standard of excellence may be much lower than that of the supply company's engineer, and after the City Council's fee is paid, and permit given, the supply may be refused. We should think that such espionage would become intolerable, and that if would-be consumers knew the facts, they would leave electric lighting severely alone, and use candles.

Municipal supervision of this kind would never find favour in England, and we should think it would cause trouble in America.

We should be glad to welcome in England any reasonable measures which would effectually drive bad wiring out of the field; but we think it may be safely left to the fire offices and the supply undertakers' engineers, provided they are properly backed up by legislation—whether compulsory or permissive only.

The imposition of fees for inspection of private premises on the part of the municipality, when such inspection is rendered by it compulsory, is bad in principle. If the wiring is bad the consumer alone suffers, unless it is so utterly bad that all precautions have been neglected—such as an entire absence of cut-outs and other defects almost inconceivable in the 19th century—when, in case of fire, it may of course spread to other premises.

In any case, if the present condition of house wiring in Chicago has necessitated inspection, fees and penalties as above set forth, it must be pretty bad, and we may congratulate ourselves that it is at any rate not necessary in England.

THE INSTITUTION OF ELECTRICAL ENGINEERS.

At the meeting of the Institution of Electrical Engineers held at the Institution of Civil Engineers, on Wednesday, the 9th inst., the discussion on Major-General Webber's paper, "Notes on the Electro-Chemical Treatment of Ores Containing the Precious Metals" was resumed, and on completion of the discussion Mr. Sherard Cowper-Coles read a paper describing "An Electrolytic Process for the Manufacture of Parabolic Reflectors."

Mr. Sulman had evidently not exhausted his offensive ammunition in the speech he made at the previous meeting, and the first contribution to the discussion on Major Webber's paper—after the routine business had been got through—was a categorical list of questions submitted in writing by Mr. Sulman, wherein he returned to the attack on the Pelatan-Clerici process with renewed ardour. In a series of 12 elaborate questions he sought to demolish M. Pelatan completely, and although his rival made out a very good case in his replies, we cannot but thank Mr. Sulman as being the agent by whom a very valuable appendix to the paper was obtained.

The more important items of information were, that the capital cost per tank of a plant for the treatment of 100 tons of ore per 24-hour cycle is: Treatment tank, 9 feet diameter, capable of dealing with 5 tons per day, costs £60; 20 such tanks are required, and the whole plant costs, say, £5,000, exclusive of crushing apparatus. Respecting a statement in the second question that with a sludge containing only 60 per cent. of water, one horse-power is usually found necessary for agitation, M. Pelatan replied that the power depended upon the nature and density of the ore; as little as one-fifth of a horse-power had been found sufficient, while the figure in the paper was ample. If one horse-power were required it probably included that necessary to revolve the containing vat or barrel.

Coming to the cost of treatment per ton with a plant capable of dealing with 100 tons per 24 hours, M. Pelatan gave the following figures in reply to Mr. Sulman:—

	s.	d.		s.	d.
Chemicals	2	6	to	4	0
Power	1	0	„	1	6
Labour	0	6	„	1	0
	4	0	„	6	6

600 lbs. of mercury were used in each tank, the loss being due to mechanical causes and amounting as a maximum to 2 ozs. per ton of ore. No attempt is made to recover the

cyanide. It was claimed for the process that it was exceptionally suitable for ores which yielded very poor or no results by ordinary methods, and as it can deal with ores crushed to pass through a very fine mesh, it evidently can deal with slimes.

The catechism ended, Mr. McMillan then read a communication from Mr. D. A. Louis, in which this gentleman—well known to many as a chemical expert who has paid special attention to metallurgical questions—expressed his feeling that the paper was admirably conceived, commented upon the general data offered, stated he thought the mill illustrated prodigious, and made some remarks upon the lack of particulars as to profit obtained, the cost of labour, &c. Apparently his desire for further information would have been satisfied to some degree had Mr. Louis been aware of the answers given by the inventor to Mr. Sulman. Mr. Cooper spoke briefly on the term "nascent chlorine," as used in the paper, and was afterwards answered by General Webber, who explained that sodium chloride was essential to the process for reducing the resistance of the electrolyte.

General Webber was then called upon to reply, and he did so, commencing by remarking that there was no reservation to the pleasure offered him by the observations of all the speakers. The paper was intended to consider the scientific, and not the commercial side of his subject, and chiefly was he concerned with the electrical side of the question. The fact that what he had dealt with was an electro-chemical process, was his reason for laying his paper before electrical engineers. If electricity were of no use, his paper was one to be brought only before mining engineers; but in bringing it under the notice of the members of the Institution, he desired to direct attention to the assistance that electricity afforded to an industry, the immense extent of which was perhaps not generally or fully realised. He thought that the younger members would do well to study the question as it fell to them to carry it on.

The replies to the criticisms in the discussion were complete and interesting. Briefly summarising what was said in a few lines, the author pointed out that the MacArthur-Forrest and Siemens-Halske processes were for the treatment of tailings; the methods for dealing with slimes had only quite recently approached practical solution. Three processes had generally to be employed:—Concentration, treatment over amalgamating plates, and finally with cyanide and deposition of the tailings. The descriptions of many processes failed to give any idea of the time occupied or the space required by the plant. The costs were difficult to give where labour is a factor that varies everywhere, and this factor alone may range from 2s. a day in one case, where a given plant is considered, with Kaffir hand labour up to 10s. or 12s., where white labour is employed. Messrs. Sulman and Teed were twitted with not giving any costs or scientific details of their own processes, which is a percolation one pure and simple. The cost of the Pelatan-Clerici process is governed by local questions; the variations for different classes of ore are effected by altering the length of time and quantity of chemicals.

Turbidity must be absent in the Siemens and Halske process, and the same condition is essential to success in all circulation processes: a great many more than those mentioned have been invented, and even put to work.

The president, Mr. J. W. Swan, followed General Webber with a few remarks that were useful in giving those present who were not metallurgists, a clear idea of the difference in processes. Thus the one before the meeting was intended for the amalgamation of gold that had not been brought into solution, its main object being to put the gold in a condition favourable for being taken up by the mercury. On the other hand, the Siemens-Halske process was one for the simple deposition of gold from a clear solution of gold already dissolved by cyanide.

Mr. Sherard Cowper-Coles then gave the description of his process for the production of projector mirrors, which was rendered all the more interesting by the use of the projection lantern, whereby a number of instructive slides were thrown upon the screen and explained to the audience by the author. In brief, the method consisted in depositing copper electrolytically on the back of a silver coating thrown down chemically on the surface of a glass mould of the desired form, the silver being afterwards covered by a coating of palladium to protect the silver from tarnishing. The silver and copper reflector is separated from the glass mould by heating in water to 120° F.

Mr. Grove thought the method was of particular value, as it enabled a projector mirror to be produced which did not require the excessive care in handling of an ordinary mirror, while it would probably be less effected by the bluish-white soot thrown off by the arc, and would, perhaps, be applied with advantage to the manufacture of the opaque screens used in projectors to maintain the parallelism of the beam by cutting off the direct rays coming from the front of the arc. General Webber conceived that this field of improvement might be of immense benefit to those who had to conduct the defence of our coasts in times of danger or under threat of invasion.

Mr. Mordey rose to protest against the assumption, implied in the observations of some speakers, that the Institution was not concerned with the "cost," or questions of cost. He thought that articles should be produced as cheaply as possible, and humorously remarked that while engineers are those who direct the forces of nature to the benefit of mankind, if the expense of any process is so great that man has nothing to eat, it is not much good to direct the forces of nature to his advantage. Mr. J. W. Swan congratulated Mr. Cowper-Coles very warmly upon his success in devising the process described, as he had considered the question years ago at the suggestion of Major Bagnold; but, foreseeing many objections to an electrolytic method, he had never ventured to combat them, and was pleased to find that such methods had proved so successful in the hands of the author.

The meeting adjourned with the interesting notification ringing in their ears that the next paper would be one by Mr. Binswanger-Byng on 200-volt fittings. The Institution has done well to procure papers on such "live" subjects as accumulator traction, electro-chemistry and now electric lighting. No doubt our friends—the station and contracting fraternity—will be glad to get back to a subject about which they have more to say than the extraction of gold—from ores.

THE "ALLAN" ACCUMULATOR.

This accumulator, manufactured by Allan & Adamson, Limited, has now been on the market for nearly three years, having undergone many severe and searching tests, not only at the company's works, but at the hands of others. The battery has quietly and steadily pushed its way forward, but the company decided not to court publicity in any special way until the most efficient methods of manufacture had been decided upon, and the battery had given satisfactory evidence of its durability.

These matters having now been firmly established, the company has no reason for further delay in bringing the accumulator more prominently before the electrical world; the more so, that recently a very important and valuable improvement has been made upon the plate, affecting its mechanical strength, and its efficiency as a support for the active material.

The plate is (as suggested by the last remark) of the pasted form, the paste or active material being supported in a hollow frame, both + and − elements being of similar construction. The hollow frame has lattices extending from edge to edge on both its sides, whilst the edges are perforated, and the paste is forced into these perforations to insure its more perfect support. Until recently the frame, cast in one piece, had the bevelled edge of its lattices on the outside, bevelled sufficiently to enable the frame to easily leave the mould, whilst the inner surface of the lattices were cast flat against the core; this form of lattice was deemed defective, as not securely locking the active material within the frame, and the attention of the management was directed towards *reversing* the lattices, whilst still casting the frame in one piece. This difficulty was ultimately overcome by a very ingenious method of casting (devised by Mr. Allan), which we are not at liberty on the present occasion to describe. The advantage of this improvement, however, must be at once apparent, as, by the new method of construction, the active material is preserved in one unbroken mass throughout the frame; that is, the frame supports the active material wholly from

the *outside*. It is this peculiarity which confers upon this plate its freedom from *buckling*.

The composition of the paste is of such a nature as permits it to be made of almost any degree of hardness during formation without in any way lessening its power to discharge at very high rates; indeed, in this respect, it is claimed that the "Allan" accumulator is unusual, as its rate of discharge for three hours is said to be 1·5 amperes per pound weight of complete cell, whilst its average capacity in watt-hours, at a similar discharge rate, is equal to 9·0 per pound weight, the total ampere-hour capacity being equal to 6 amperes per pound weight, *also* of complete cell. A further idea of its capacity, weight, and size of a battery, may be gained by giving the following quotation from a tender which has just been submitted for use on a new electrically-driven cab:—

"Forty cells of 210 ampere-hours *guaranteed* capacity. The weight of these cells, complete, will not exceed 1,300 lbs., and they will measure outside 35 inches × 34 inches × 12 inches high."

The "Allan" accumulator makes strongly for traction. Its high capacity and discharging rate for its weight, its lightness, strength, durability, and immunity from buckling, all render it peculiarly adapted to this class of work.

Light and small, it can be more easily handled, and we all know that batteries, as a rule, suffer more in handling than they do in the actual work done by them. Aiming at perfecting their accumulator for traction work, the company is convinced that all other uses are being met at the same time.

The manufacturers consider the batteries admirably suited for every class of work, and having given them a thorough test for durability, are prepared to guarantee them and to substantiate the figures given.

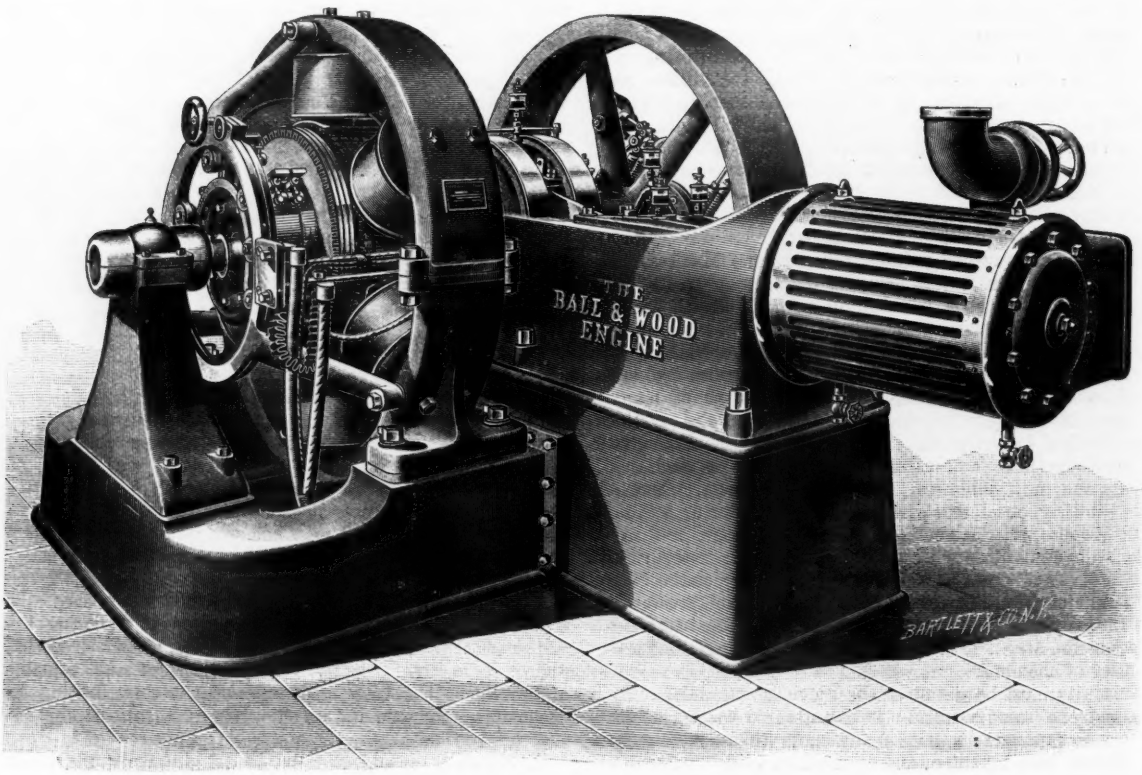
Several test sheets have been sent to us, all of which make out a remarkably good case for the "Allan" cell, but we have not space at our disposal to publish these.

We have, however, had an opportunity of seeing the process of manufacturing the plates, and of seeing several of the cells in operation, and there seems to be no reason why the merits claimed for this type of secondary battery should not be fully borne out in practical operations on a large scale. In any case electric traction experts will do well to fully investigate the claims made for this battery before deciding upon a choice of accumulator either for tramcars or other electrically-driven vehicles.

The North Metropolitan Tramway Company has had at least two sad experiences of the uses of secondary batteries on certain sections of its lines. Is it too much to hope that its enterprising and far-seeing managing director may see his way to yet another, and we trust commercially successful, venture?

THE BALL AND WOOD ENGINE.

One of the examples of the high speed American horizontal engine being introduced into this country by Mr. F. Nell (already so well known as a supplier of turbines), of 97, Queen Victoria Street, is that known as the Ball and Wood Engine. It is one of a box frame type, with over-hung cylinder and two fly-wheels with fly-wheel governor, and is claimed to regulate to 1 per cent. between abrupt changes of no load and full load. In this engine there is a peculiar slide valve which works between top and bottom faces. The ports are on the lower face, the steam entrance is in the upper face. The valve is in two parts, kept apart by the steam which is inside the valve, the two parts being joined by a telescopic sleeve. Exhaust takes place into the valve chest. The face pressure is thus moderate and constant, and the wear even. The system of lubrication adopted is that of the oil pipe, clean oil from a reservoir being led to the parts through a filter and adjustable sight feed.



The Ball and Wood engine is one of those developed to its present perfection by the electrical industry, and in our illustration we show one of these engines directly coupled to a dynamo.

The sub-division of units has made the demand for economical engines of small power very large. Before the days of electric light, small-powered engines could not be obtained of economical type. The same tendency to use several units has spread to ordinary factories, where several small engines of good type are better than one large engine, probably owing to the great convenience they offer in running a department overtime when other departments are stopped.

In these engines there are double-disc counter-balanced cranks, the balance of the moving parts being thus direct and equally distributed on each side of the centre line. The two fly-wheels are outside the frame, and are made with a split boss, the split being radial only, and not diametral. When placed on the shaft, the boss is tightened by a stout through bolt, and opposite the bolt are two keys held tight by set screws. To put the wheels on their shaft it is only needful to use a small wedge to slightly open the boss so as to enable it to slip easily in its place. The governor, of fly-wheel type has the inertia weight and spring, and the inertia aids the centrifugal force. The weight arm is hollow, and has pockets for weights to vary the normal speed. The governor acts by moving the eccentric across the end of the shaft in such a way as to give a lead varying with the cut-off from a maximum at the latest point to zero, when the weights are in their extreme out position. Some idea of the powers of these engine may be gathered when we say that the 10 inches by 11 inches single cylinder engine run at 300 revolutions, will give 54 H.P. at 80 lbs. initial pressure.

The 16 inches by 16 inches engine at 250 revolutions, gives 211 H.P. at 100 lbs. initial.

Where an engine is wanted for direct connection, the bed or frame is made to suit the dynamo frame desired so as to obtain a harmonious combination.

In the catalogue before us, diagrams are shown from a 9 inches × 10 inches at 325 revolutions, which show a reduction of load from 300 to 75 amperes in 10 seconds. The diagram of each revolution is fairly closely traced as the load was taken off, and the governor action is made very plain.

The Ball and Wood Company do not confine themselves to small horizontal engines, or even to horizontal engines. They make also engines of vertical type and large size, for either direct connection, belt, or rope driving.

THE MEASUREMENT OF INSULATION RESISTANCE BY ALTERNATING CURRENTS.

For some time past, a rule has been in force in Germany which requires that the insulation resistance of any electric installation which is to be connected to the supply mains, shall be at least equal to $\frac{1,000,000}{n}$ ohms, when n is the number of lamps fixed; and, further, that the test shall be made with a pressure equal to that at which the circuit will be worked. In order to avoid the necessity of carrying about a battery capable of giving a testing pressure equal to the working pressure of the circuit, various methods have been suggested of making the test by means of current taken from the supply mains; and these methods, particularly in the case of alternating current supply, have lately formed the subject of articles in both German and French technical journals.

One of the methods proposed consists of connecting one pole of the supply mains through an alternating current voltmeter to the circuit to be tested, whilst the other pole of the supply mains is earthed; the insulation resistance being calculated, as in the case of direct currents, from the formula, $\text{R} = \text{G} \cdot \frac{\text{V} - \text{V}'}{\text{V}'}$, where G is the resistance of the voltmeter, and V and V′ respectively the readings of the voltmeter when connected between the two poles of the supply mains, and between one pole and the circuit under test. Objection is taken to this method, because the resistance of the ordinary electro-magnetic voltmeter for alternating currents is so low that the instrument cannot be used to measure the insulation resistance of a circuit where the number of lamps fixed is small. This objection is, of course, an important one, but we do not think that accurate results would be obtained by this method, even on circuits of which the insulation resistance came well within the range of the voltmeter, unless this latter was specially arranged so that the non-inductive resistance in series with the working coils formed a very large percentage of the total resistance of the instrument. Again, although one pole of the mains might be earthed if each installation was fed by a separate transformer, there would be very great objections to the earthing of one pole of a low tension distributing network.

To get over the first-named difficulty of want of sensitiveness, an instrument has been devised by the Allgemeine Electricitäts Gesellschaft, in which the fixed coil is connected across the terminals of the supply mains, and is arranged to take a current of 1 ampere or more so as to produce a very strong field, whilst the circuit of the moving coil, which is of high resistance, is connected between one pole of the supply mains and the circuit to be tested. This type of instrument should certainly give much better results than the ordinary voltmeter, but the objection to earthing one pole of the supply mains still remains, and renders this particular method of testing inadmissible in many cases. A slight modification of the method of testing would render the earthing of one pole unnecessary, but it would at the same time reduce the testing pressure from that between the supply mains to the pressure between one pole and earth; and this might be anything between the full working pressure and half that amount, according to the condition of the distributing network. Of course, the objection to earthing might be removed by using a small equal ratio transformer to supply the testing current, but this would be nearly as cumbersome to carry round as the testing battery.

A bridge method has also been proposed and tried, the galvanometer being replaced by a telephone, and the battery by a connection to the supply mains, whilst the terminals to which the unknown resistance is usually connected, are joined up, one to the circuit under test and the other to earth. This method has been tried with a working pressure of 120 volts and a frequency of 50, but was not found sensitive enough to give satisfactory results, and although it is stated that accurate measurements could be made when the testing current was supplied by an induction coil instead of from the supply mains, the method does not appear to us to have any advantages likely to bring it into general use.

If any method is to be used in which the testing current is taken from the mains, we would suggest that the circuit to be tested should be connected to one pole of the supply mains through a non-inductive resistance, and that the potential differences between the terminals of this resistance, and between the supply conductor and earth should be measured by an electrostatic voltmeter. The insulation resistance of the circuit would be given by $\text{R} = r \cdot \frac{\text{V} - \text{V}'}{\text{V}'}$ when r is the value of the non-inductive resistance, and V and V′ respectively the readings of the voltmeter when connected to earth and across the terminals of the resistance. The value of the resistance, r, must, of course, be such that it is at least equal to $\frac{\text{R}}{x - 1}$ if R is the highest insulation resistance to be measured, and x the ratio of the highest and lowest readings of the voltmeter.

ENCLOSED ARC LAMPS.

Since the introduction of the commercial arc lamp, says the *Electrical World*, in 1878 no improvement has been made in its development that can compare with commercial value with the enclosed arc principle. The use of the enclosed arc has practically revolutionised the arc light industry, and, says our contemporary, one of the earliest and most successful lamps of this character placed upon the market was the Jandus double enclosed arc lamp. This lamp, which is manufactured by the Jandus Electric Company, Cleveland, Ohio, has been before the public for the past three years, both in Europe and America. The Jandus lamp burns directly across the terminals of a potential circuit without waste of energy. This makes it desirable for a street lighting system where multiple circuits are used, and for an underground system it is particularly adapted, because lamps can be connected wherever necessary without the inconvenience of running connecting wires between pairs of lamps or installing two lamps where only one is needed, or wasting the energy of one lamp, as was necessary under the old system of connecting two lamps in series. For interior lighting, the economy and

convenience of burning lamps singly cannot be over-estimated. The Jandus lamp has been highly endorsed by the Board of Fire Underwriters generally. Mechanically and electrically it differs greatly from any other lamp. The action of the lamp is extremely simple. There is only a single winding which forms the solenoid. The armature is held suspended in a strong magnetic field formed by the iron frame of the lamp, which surrounds the winding. The regulation of the lamp is maintained by the weight of the armature, which is considerable, opposing the pull of the magnet. When the arc becomes too long, from the consumption of the carbon, the magnet will weaken, owing to the decrease in the current flowing through it, caused by the increased resistance of the arc, and the armature will fall a little until the arc has regained its normal strength, and the current consequently restored, when the magnet will again hold the armature stationary. The armature is the plunger for its own dash pot, formed in a brass tube inside the coil. The carbon, extended by a tube or sheath, is inserted directly into the clutch, consisting of a pan-shaped piece, carrying four clutch rings, which fall by gravity and grip the carbon between the inclined side of the pan and the carbon. The clutch releases this and allows the carbon to feed when the armature has descended, until the clutch rings rest upon the releasing tube. This form of clutch allows the unequal sizes of the carbons and sheath to be fed through it with equal accuracy. The current is conducted to the carbon through a series of 16 contact rings, which are arranged in a circle and make a flexible contact with the carbon. One of the great advantages of the absence of the carbon rod is that the current is conducted from the mechanism directly to the carbon. The upper carbon is held concentric with the lower by the globe cap, which is centred by the guides on the bottom of the box enclosing the contact rings. The armature carrying the clutch is therefore the only movable part in the entire mechanism of the lamp, the absence of springs or adjustments being one of the most notable features. The yoke supports the inner globe and the lower carbon holder at its bottom end, where a ring admits the arms of the spider carried on the lower holder. This spider, by a turn to the right, locks the holder in position, and closes the electrical circuit through the lamps. The outer globe is secured to the yoke by a circular nut, and is closed, air-tight, at this point by means of asbestos gaskets. The Jandus standard lamp for outdoor service is provided with a waterproof case, and the terminal wires are led through water-tight rubber bushings, no hood being required. The rheostat is placed below the lower carbon holder inside the outer globe in a position where it will cast no shadow, and is thoroughly protected from the weather and readily accessible. In the lamp for inside service the rheostat is placed in a canopy at the top, where it can be readily adjusted by dropping the top half of the canopy. A cut-off switch is provided in the canopy. The Jandus lamp is claimed to embody the following advantages: Long life (the lamps burning 150 hours on a single half-inch carbon); lamps burn singly with economy on 110-volt circuit; perfect diffusion and uniform distribution of light; absence of flickering; practically noiseless in operation; fewness of working parts; decrease in cost of repairs, and small size.

THE PROTECTION OF ELECTRIC POWER TRANSMISSION CIRCUITS FROM LIGHTNING.*

By JOHN T. MORRIS, Stud.Inst.C.E.

THE importance of efficiently protecting electric power transmission circuits from lightning is shown by the fact that in some of the earlier installations it was found more economical to shut down the generating plant than to run the risk of an armature being burnt out, or other similar mishap, during a severe thunderstorm. The danger lies not so much in the conduction of the discharge to earth as in the arc, started by the lightning, being maintained by the current. After demonstrating in a curve the relation between the sparking distance and voltage, the author shows that the discharges from which the line must be protected are of three kinds: (1) Those due to lightning actually striking the line; (2) the rush and surgings of electricity induced in the line; and (3) those due to slow accumulation of the charge. Discharges of the first kind are extremely rare, those of the third are occasional, while those of the second are the most frequent. The methods of preventing discharges from entering the circuit are described: at Niagara and Grünberg an earthed wire is stretched along the circuit a short distance above the conductors; and the means of providing opportunities for the discharge, after having entered the circuit, from passing to earth, are detailed. Lightning arresters may be divided into two classes: those in which the line is permanently connected to earth through a high resistance, and those consisting of a short spark-gap, one terminal being connected to earth and the other to the line. Examples of both types are explained, and the various methods of extinguishing the arc are dwelt with, typical instances of each being described. After dealing with the non-arcing properties of some metals, such as zinc, cadmium, antimony, bismuth, &c, the author proceeds to detail arrangements for good earths, and the methods, such as by choking-coils, of preventing discharges passing along the line to the power-house; the best positions of arresters in power transmission and tramway work are shown, and a description is given of a 15,000-volt 3-phase arrester and choking-coil rack. The author concludes by considering the number of arresters required upon a circuit: recent experience has shown that one per mile in sheltered places, and as many as twleve in exposed positions are necessary to ensure a reasonable degree of safety. The principles employed in some arresters were illustrated by experiments. Numerous specimens of different arresters used in power transmission work were exhibited.

* Abstract of paper read before the Institution of Civil Engineer Students, February 11th, 1898.

SOAMES'S MOTOR-TESTING BRAKE.

THIS brake, which is being introduced by the Davies Motor Company, is of extremely simple construction, and gives perfectly definite weighing of the torque on the pulley under test against ordinary dead weights. It consists of a steel lever working on knife edges, which can be raised or lowered by the hand-wheel at the top of the brake. Holes are drilled in the lever at equal distances from the centre, corresponding to the ordinary sizes of pulley in use. The centre of the brake is placed over the centre of the pulley, and from the two holes corresponding to the diameter of the pulley under test is suspended a piece of webbing, which passes round the pulley, as in the

diagram. When the pulley is running, a weight, say, from ¼ to 30 lbs., is suspended on the end of the arm, as shown. The whole is then raised by turning the hand-wheel, tightening the belt on the pulley until sufficient friction is put on the belt to raise the arm to a horizontal position and keep it floating there; the speed of the pulley being taken at the same time. The usual constant, viz., $2 \pi L \div 33{,}000$, L being the distance of the weight from the centre, mult plied by the speed and the weight, gives H.P. direct. The size of the pulley, which should be perfectly smooth and flat, does not enter into the equation, so long as the distance between the holes in the arm is equal to its diameter; the band *must*, in all cases, be hung from two holes equidistant from the centre. It is stated that every reading can be repeated with absolute certainty, and that each one does not take more than 10 seconds at the outside.

HORSE-DRAWN CABS v. ELECTRIC CABS.*

The actual expenses of operating vehicles are very difficult to obtain in this country, both the costermonger and the railway director displaying a suspicious reticence when asked for information, which is not a little amusing. Our French contemporary, *La France Automobile*, has, however, succeeded in obtaining such information as is applicable to Paris, and we reproduce it here as being an eminently instructive comparison. Moreover, we think that the prices do not differ greatly from those ruling in London:—

Daily Cost of a Horse and Cab.

	Francs.
General expenses	0 53
Financial expenses	0.30
Tickets (cabman's)	0.01
Apprenticeship and sundries	0 05
Provident fund	0.07
Fire insurance	0 02
Lighting of carriages and depôts	0.11
Heating " "	0.02
Water	0.03
Syndicate expenses	0.05
Accidents and damage	0.35
Rent of depôts	1.05
Depôt staff and employés	0 99
Rates and taxes	2.26
Food, shoeing, and wear and tear of horses	6.65
Renewing and wear and tear of rolling stock	2 74
Wear and tear of property	0.21
12s. 4d. =	15.44

Daily Cost of an Electric Cab

(The number of carriages being equal in the two cases).

	Francs.
General expenses	0.17
Financial expenses	0.08
Tickets (cabman's)	0 01
Apprenticeship and sundries	0 05
Provident fund	0.04
Fire insurance	0 01
Lighting of carriages and depôts	0.05
Heating " "	0.01
Water	0.06
Syndicate expenses	0.05
Accidents and damage	0.24
Rent of depôts	0.35
Depôt staff and employés	0.50
Rates and taxes	1.50
Electrical energy and accumulators	2.20
Renewing and wear and tear of stock	2 74
Wear and tear of property	1.07
7s. 4d. =	9.13

Allowing for an under-estimate there is still a large balance in favour of the electrical cab.

BUSINESS NOTICES, &c.

Announcement.—Mr. S. Harrison, of Wigan, informs us that the delay in the execution of orders, occasioned by the recent fire is at an end, and that he is now in a position to give prompt delivery. He has, moreover, secured larger premises at 73, Wallgate, Wigan, to which the workshops and showroom will be transferred as soon as the necessary alterations are completed.

Business Announcement.—Messrs. Reed & Jenkins have opened a showroom at High Street, Bristol, and are generating their own current by means of a Silvertown dynamo driven by a Crossley gas engine. They are agents for the Stewart enclosed arc lamp.

Dissolution of Partnership.—Messrs. J. McLellan and G. J. Wells (John McLellan & Co., electrical engineers, 19, Station Road, Blackburn), have dissolved partnership from May 31st, 1897. Debts to be attended to by J. McLellan, who continues the business under the old name.

Liquidation Notices.—Mr. J. H. Thornton, of 2, Warwick Street, Regent Street, London, W., liquidator of the National Company for the Distribution of Electricity by Secondary Generators, Limited, gives notice to creditors that they must send notes of their debts or claims, and the usual particulars, to him on or before Tuesday, March 15th.

Mr. R. H. Marsh, of Ethelburga House, Bishopsgate Street Within, E.C., also gives notice that creditors of the Crompton-Howell Electrical Storage Company, Limited, must send to him as the liquidator, particulars of debts or claims, on or before March 25th.

Creditors of the Electrical Traffic Syndicate should send particulars of their debts or claims and the usual information to Mr. Maurice Jenks, 6, Old Jewry. E C, liquidator, by March 26th.

* *The Automotor and Horseless Vehicle Journal.*

Electrical Wares Exported.

Week Ending Feb. 15th, 1897.	£ s.	Week Ending Feb. 15th, 1898.	£ s.
Albany	158 0	Aden. Teleg. mat.	22 0
Alexandria. Teleg. mat.	140 0	Amsterdam	80 0
Amsterdam	50 0	Antwerp	244 0
Auckland	328 0	Auckland	47 0
Brisbane. Teleg. poles	526 0	Bangkok	229 0
Bombay. Teleg. mat.	59 0	Barcelona	210 0
Brussels	10 0	" Teleg. wire	98 0
Calcutta	790 0	Boulogne	20 0
Cape Town	321 0	Buenos Ayres. Teleg. mat.	478 0
Corfu. Teleg. mat.	23 0	Calcutta	851 0
Durban	408 0	Cape Town	25 0
East London	340 0	Clinde	156 0
Gothenburg	8 0	Colombo	60 0
Hamburg. Teleg. mat.	225 0	Delagoa Bay	1,832 0
Hobart	31 0	Durban	3,001 0
Malaga	155 0	Flushing	60 0
Port Elizabeth	161 0	Gibraltar	538 0
Rotterdam	276 0	Gothenburg	123 0
Shanghai	527 0	Hong Kong	150 0
Sydney	1,181 0	Leghorn	122 0
Trinidad. Telep. mat.	48 0	Lisbon	48 0
Wellington	560 0	Madras	5 0
" Telep. mat.	2,320 0	Melbourne	762 0
		Napier	10 0
		Ostend	50 0
		Port Elizabeth. Teleg. mat.	450 0
		Shanghai	115 0
		Singapore	178 0
		" Teleg. wire	61 0
		Sydney	335 0
		Trinidad	22 0
		Wellington	77 0
		Yokohama	935 0
Total	£8,644 0	Total	£11,374 0

Concentric Wall Connections.—Mr. A. P. Lundberg sends us a sample of the "Gem" concentric wall connection, which he is just putting on the market. It is claimed to be simple in construction, small in size, and neat in appearance. Safety is claimed as one of its good points, as the brass parts of opposite polarity are well separated, and on this account wilful short-circuiting is made a

more difficult matter; the small hole in the cover (the plug being only ¼-inch diameter) is also an advantage. In outside appearance it closely resembles the "Dot" two-pin wall connection, which is in great demand, and can be fitted with similar varieties of covers and plugs as that pattern. It is only 1¾-inch diameter, and 1¼-inch height over all when plug is in connection with socket part. A long fuse is provided for, if such is required, and all plugs and sockets are made interchangeable.

Electric Clock-Switch.—A patent automatic electric clock-switch (Wheatley, James & Browne's patent) is being placed upon the market by Messrs. James & Browne, 39, Victoria Street, S.W. The instrument is specially designed for shop window lights, street lamps, advertising signs, &c. Its object is to automatically switch "on" and "off" at any desired time, the weekly winding of the clock being the only attention necessary. It is fitted with a quick make-and-break mercury switch, which has been found to work thoroughly satisfactorily both on arc and incandescent circuits. The mechanism involving the patent is very simple, though reliable. A single transmission wheel connects this mechanism with the clock, which is a pendulum movement. The instrument is enclosed in a painted iron case, and the dials are covered by a circular bevel glass in polished glass rim. For outdoor use it is enclosed in a dust-tight, damp-proof case, which can be fixed either in the base or attached to any lamp standard.

Electro-Chemistry and Water-Power Utilisation in Switzerland.—A company is in course of formation at Berne, with a capital of £80,000, to be known as the Electro-Chemische Industrie Gesellschaft, to put down plant to utilise certain available water-power, and to erect an electro-chemical factory near Thusis.

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Electric Lamp Carbons in Canada.—It is reported that new works for the manufacture of arc lamp carbons by a special process are about to be established at Brockville, Ont.

Fire Alarms.—The houses of the members of the fire brigade are to be connected by means of electric alarms.

Foreign Cable Agency.—A first-class London firm, well connected with the electrical trades, is required to represent a foreign cable factory in England and British Colonies. Applications are to be addressed to K. E., 763, care of Rudolf Mosse, Cologne, Germany.

Harrison Coles & Co. v. Radford.—At Wandsworth County Court on Monday, Messrs. Harrison Coles & Co., sued Mr. Joyce Radford, of the Station Hotel, Richmond, for the cost of installing the electric light. The case was settled by defendant agreeing to pay £18 provided the work was done satisfactorily.

Institution of German Electrical Engineers.—The annual report of the Berlin Elektrotechnische Verein states that the number of members in January was 2,444, of whom 555 were resident in Berlin. As compared with January, 1897, this shows an increase of 371 members.

King's College Engineering Society.—At a general meeting held on Friday, February 11th, Mr. J. D. L. Bradwell read a paper on the "Manufacture of Incandescent Lamps." The author, commencing with an account of the parchmentising process of making filaments, went on to describe the different processes of mounting, and the uses of flashing; he then concluded with a short description of the method of making the bulbs, and sealing in the filaments.

Krupka & Jacoby.—We have received from Messrs. Krupka & Jacoby a set of illustrations of figures and wall decorations for electric lighting, of which we give an example, as the showrooms

of the firm at 62, Watling Street, are now stocked with a great variety of this special class of goods; those who need fittings of an ornamental character should not omit to pay them a visit, for the designs are extremely beautiful and artistic.

Lists.—The Phœnix Glass Company, of New York (London representative, Mr. A. L. Gibson, 4, Queen Victoria Street, E.C.) sends us a list of the Davis Indicating Globe. This is a globe in the shape of a hand, with a finger pointing to "office," "exit," &c., these words being on the back of the hand in black. The globes are made in opal, ruby, or flesh tint.

Messrs. Green & Boulding, of Featherstone Street, City Road, are sending out a list dated February 1st, 1898, giving full details of the Buffalo automatic injector, also some notes of the "Shipman" engine, Tripp metallic packing, &c.

Messrs. Price & Cornell, of 15, Victoria Street, S.W., have issued a list giving an illustrated description of the Westminster gas engine ("Otto" principle). Prices and particulars of single cylinder horizontal engines, from 2 to 30 H.P., are given, also of small horizontal motors ½ and 1 H.P., and vertical motors ½ and ¾-H.P.

Lloyd & Lloyd v. D. and W. Henderson & Co.—In this action, which has already been briefly reported in the ELECTRICAL REVIEW, Sheriff Strachan has issued an interlocutor ordering an opinion of English counsel to be taken on the question. It will be remembered that plaintiffs sought to recover from defendants £600 as patent royalties for years 1895, 1896, and 1897. Pursuers hold letters patent in the United Kingdom for the Benardos system of electric welding, and at pursuers' request, they allege they had prepared a license to use the invention. Defenders delivered license again to pursuers signed by A. P. Henderson, for self and partners. The pursuers contend that by the law of England there is continuing liability for the total royalties to the end of the patents amounting to £2,600, less £400, already paid by the defenders. The defenders refuse to pay further royalty on the ground that there was no completed agreement, and that they had ceased using the invention.

Lyell v. Davies.—Judge Lumley Smith, Q.C., delivered judgment in this case at the Westminster County Court last Saturday. The plaintiffs, Messrs. Lyell & Co., electrical engineers, had an order for a frame in which the portraits of King Oscar and the Queen of Sweden were to be enclosed. They were fitted for the electric light, and were to be used in the decorations in Stockholm on the occasion of King Oscar's Jubilee. The frame was handed to the defendants with instructions to ship it by a certain boat for delivery at Gothenburg. They missed the boat, and on its arrival no artists could be obtained to paint the portraits, and the frame was therefore refused. Had it gone by the boat arranged for, it would have gone through all right. His Honour found that defendant undertook the risk knowing all the circumstances, and there would be judgment for the plaintiff for £18 with costs. Leave to appeal was given.

Packing Export Goods.—In connection with our recent comments on the necessity for more careful packing of machinery for foreign parts, we note from a paragraph in the *Times* that Germany attributes a good deal of its success abroad to the care which is given by manufacturers to packing and transport. The latest report from the British Legation in Munich contains some observations on the great importance of packing goods in such a way as to set them off to the best advantage, and of the improvements made in Germany in this respect during the past few years. Ten years ago German consular reports contained numerous complaints of defective packing and arrangement; but this has now been altered, and the Germans are said to surpass the French in the tasteful and suitable manner in which they present their wares to foreign buyers. The requirements of distant countries in regard to packing are carefully studied. The various methods of transport after arriving at the ports of discharge are known and provided for, as well as the provisions of the different tariffs, so that goods may be packed in such a way as to pay as little duty as possible.

Rochefort-sur-Mer Exhibition.—An international and colonial exhibition will be held at Rochefort-sur-Mer from June 1st to October 1st, 1898. The exhibition will be established on the Esplanade and the Roz-Bry Square. All the products of commerce industry, marine, and the fine arts will be admitted, and metallurgy, mechanics, and electricity will be special features. For all further particulars, apply to La Mairie de Rochefort-sur-Mer.

"Scientific American" Catalogue.—We have received from the publishers of the *Scientific American* (361, Broadway, New York), a cloth bound copy of their new *Scientific American Supplement* catalogue, giving, in carefully arranged form, titles of articles which have appeared in that paper on variety of subjects of scientific interest. The list is a good index, reference being made to 10,000 of the more important articles.

Scottish Cyanide Company.—We reproduce the following from the *North British Daily Mail*:—"The Scottish Cyanide Company will begin operations in a fortnight at their works at Leven. The process patented by Mr. Reymond, of Edinburgh, is purely electrical, the clay thereby being heated in its entirety, whereas by the old method this could not be secured. The electric plant is the best and most valuable laid down in the kingdom, and its cyanide of potassium will be put on the market at a much lower rate than presently secured. The capital of the new company is £200,000."

Smoking Concerts.—On Friday last, at the Grosvenor Hall, Buckingham Palace Road, between 300 and 350 employés of Messrs. Drake & Gorham, and their friends, attended a smoking concert, and a very pleasant evening was spent. Mr. Drake stated that 1897 had been the firm's record year in turnover, in spite of increasing competition, and that during the past 12 months £1,000 had been distributed among the employés in the form of bonuses.

A smoking concert of the drawing office staff and others employed at the Electric Construction Works, at Bushbury, was held at the Swan and Peacock Hotel, on 5th inst.

Water-Power.—The subject of water-power utilisation for electric lighting installations is an attractive one, and it will interest our readers to know that Mr. Alph. Steiger has just supplied and erected a new turbine plant which utilises a fall of only 2 feet, and develops 40 brake horse-power, for Mr. A. J. Taylor, of Strensham Mills, near Tewkesbury. The plant has just been most successfully started. There are probably not a dozen turbine plants in the world utilising such a low fall; but the success claimed in this instance shows that even low falls, of which there are plenty in this country, can be turned to good account.

Workshop Lighting.—Messrs. Robey & Co. have put down the necessary plant for lighting the workshops, offices, and other buildings, of Messrs. Wm. Pattinson & Sons, builders and contractors, at Ruskington.

ELECTRIC LIGHTING NOTES.

Aberdeen.—Prof. Kennedy was in Aberdeen on Saturday, and conferred with the Gas and Electric Lighting Committee *re* extensions of electric lighting to the West End, the utilisation of dust, and the proposed electric tramways. The professor will report. It is proposed to light the West Church by electricity.

Adenshaw.—The District Council recently conferred with the Manchester City Council *re* electric lighting, and the latter body offered to lay cables to supply such places as Adenshaw at the same price as Manchester residents pay.

Ashton.—The Council has approved of a design of arc lamp pillar, with incandescent lamp brackets, submitted by Mr Clirehugh. A tender has been accepted.

Ballymena.—Immediate steps are to be taken to have the town lighted electrically. The clerk to the Commissioners is to get information from English towns as to the systems.

Bermondsey.—The Electric Lighting Committee has been empowered to obtain a further report from Mr. Manville, dealing with the proposal to combine dust destruction with the electric lighting scheme.

Blockley.—On Tuesday last the small plant for street lighting was inaugurated. Messrs. T. Parker, Limited, supplied the dynamos (one for the public, and one for private supply), one being worked by a 13-H.P. turbine, and the other by a 10-H.P. vertical engine. There are 28 lamps in the streets. The cost has been defrayed by public subscriptions. Major Spencer (whose wife switched on the current) replying on her behalf, said that nine years ago the village adopted electric street lighting, and it continued until the Blockley Electric Light and Manufacturing Company dissolved three years ago, since when oil lamps had been used. Mr. H. N. Warburton was the electrical engineer for the work.

Cheltenham.—The electrical engineer has reported that the two new boilers had been erected and tested with satisfactory results, and that the first 220-kilowatt steam alternator would be ready for steam trials on February 9th. Mr. Waghorne stated that the electrical engineer estimated that the delay in the supply of machinery caused by the engineering dispute had involved the loss of something like £1,000 to the electric light revenue.

Cordoba.—From an article in a Buenos Ayres paper, we gather that the electric light and power works for Cordoba, Argentine Republic, are in so advanced a state, that in the course of a few weeks supply may be commenced. Turbines and dynamos are in position at Casa Bamba. The cables are completed to Cordoba, 22 kilometres in length, and some of the mains in the city as well. The company utilises the power of the river fall between Dique de San Roque and Mal Paso, on the Rio Primero. At Casa Bamba a tunnel, 90 metres long, and 3½ metres diameter, has been made through the hill, connecting the two extremities of a great bend in the river. Water is conveyed from the tunnel to the turbines by a 2-m-tre iron tube. When further plant is put down to the extent provided for, there will be 5,000 H P. available. Current is conveyed by overhead conductors at 10,000 volts. From Casa to Cordoba there is a line of posts bearing three 9-mm. copper wires, and three wires for protection from lightning. At the Casa Bamba station transformers raise the voltage, and near the Observatory it is reduced to 2,000 volts, and subsequently to 210 and 115 volts respectively for power and lighting of consumers' premises. The general manager of the Electric Light and Power Company at Cordoba is Mr. Theophilus Greenwood. The company has numerous applications for current.

Country House Lighting.—The Grove, Witham, has been lighted by electricity for Mr. Percy Laurence. Messrs. Laurence, Scott & Co. supplied the plant, and Messrs. Strode & Co. carried out the work. There are 200 lights in the mansion and other buildings.

Lord Wantage has given the order to the National Electric Free Wiring Company, Limited, for supplying and erecting a complete installation for electrically lighting "Downs" House, near Wantage. The installation comprises steam engine, boiler, dynamo, storage batteries, switchboards, mains, house wiring and fittings. The wiring is all to be on the "patent Twin system," owned by the National Electric Free Wiring Company, Limited.

Coventry.—The monthly return of the electric light department shows an increase over the corresponding period last year. For the past few months the returns have shown a steady increase.

Crieff.—On 7th inst. the Town Council met in private to consult with Mr. R. Frederick Yorke, A.I.E.E., as to the proposals he has made in regard to electric lighting for the burgh. Mr. Yorke thinks though £8,000 would, in his opinion, be necessary to carry out the scheme he proposes by water power, the working expenses would be nothing approaching the outlay if steam power were to be used. He would propose to convey the current from the Turret or Barvick Falls to Crieff by overhead wires. He is of the opinion, if a local company could be formed for carrying out the scheme, the town would be relieved of all responsibility in the way of raising capital, &c.

Greenock.—Last week we stated that Mr. Tighe, of Paisley, was being consulted by the Commissioners on the electric lighting question. This should, of course, be Mr. Teague, of Paisley.

Hartlepool.—In connection with the proposal to combine dust destructors with electric lighting here, a Corporation deputation visited Leyton last week to inspect the destructor there.

Hyde.—The Council is to apply to the Local Government Board for a further loan of £1,000 on the Technical School account for electric lighting and other purposes.

Ipswich.—The electric lighting order having been obtained, various proposals were before the Town Council recently, as to what should be done next. One motion was, that the Electric Lighting Committee be re-appointed, with instructions to proceed with the necessary works at a cost of £36,200; but ultimately an amendment, requesting the committee to carefully consider the offers received by private parties for the purchase of the order, was carried.

Kettering.—Letters have been received from the Municipal Electric Supply Company and the Electric Extension Company *re* electric lighting. Further consideration has been deferred by the Council for three months until the new Council is in office.

Kingston.—The fourth annual report of Mr. J. E. Edgcome, borough electrical engineer, shows that after payment of all the works' cost for generation of electricity, maintenance, and repair of machinery and mains, &c., there remains a balance of £867 19s. 9d., as compared with £301 3s. 1d. for 1896. This sum is sufficient to pay the interest for the year on the capital expended on the undertaking, leaving a balance of £43 12s. 1d. towards the repayment of the principal.

Leeds.—The Yorkshire House-to-House Company, and representatives of the Corporation, conferred together on 8th inst. respecting the proposed purchase of the undertaking by the municipality. It is probable that the whole matter will be thrashed out before the Local Government Board inquiry, to be held in a week or two.

Liverpool.—The Much Woolton Urban Council is proceeding against the Liverpool and District Electric Lighting Company for having caused a smoke nuisance at the generating station at Gateacre.

London.—Mr. T. W. E. Higgens, surveyor to the Chelsea Vestry, has drawn up a report with regard to the Metropolitan Electric Supply Company's Bill before Parliament, in so far as it affects the parish of Chelsea. He states that the company are supplying electricity in various areas, and, being unable to acquire land for larger generating stations within the areas supplied by them, have purchased a site in Willesden and Acton, upon which they are erecting a generating station, and they seek Parliamentary sanction to convey electricity from this station to Amberley Road, Paddington, by means of two lines of cables, one laid under the towing path of the Grand Junction Canal, and the other under the roadway of Harrow Road. The Chelsea surveyor thinks that the Vestry should oppose the laying of any mains in Harrow Road, unless the company will undertake to supply electricity for public and private purposes at Kensal Town at a cost of not more than 4½d. per unit.

Lowestoft.—At the last Council meeting Mr. Fry, chairman of a Special Committee, reported in favour of the Horsfall destructor, of high temperature and forced draught. A rough estimate of the cost was £3,000, which would effect considerable saving on the present system. Smith's Marsh had been practically decided on as the site of the electric station, and there would be plenty of room there for the destructor. The question was referred to the Sanitary Committee to obtain tenders and apply for a loan for the combined scheme.

Lynn.—After receiving a note of the terms of several consulting engineers for reporting and advising *re* electric lighting, the Corporation has appointed Prof. Kennedy.

Newmarket.—A local company has been formed to take over the electric lighting order which Messrs. Edmundson, Limited had agreed to purchase from the Council.

Pembroke.—Mr. Robt. Hammond explained his electric lighting scheme to the Commissioners on 7th inst., and the Electric Lighting Committee was afterwards instructed to proceed with the scheme, the estimated cost of which is £32,500. The proposed compulsory area includes four miles of lamps, and the scheme provides for 7,500 lamps, though the station chimney and buildings will be large enough for plant for 15,000 lamps.

Peterborough.—The Local Government Board inquiry into the application for a £15,000 electric lighting loan for the Council was held at the Guildhall last week. The inquiry lasted three years.

Plymouth.—An electric lighting plant, comprising a Taunton dynamo and Crossley gas engine, has been put down for a new *café* at 45, George Street. An electric motor is to be employed for coffee grinding and roasting machinery.

Poplar.—We learn that at an expenditure of about £50,000, the District Board of Works have resolved to adopt electric lighting.

Portsmouth.—Owing to the collapse of the engineers' strike, Alderman G. Ellis, J.P., estimates that within six weeks or two months there will be sufficient current available to supply 10,000 extra lights. A member advocated dust destruction in connection with the installation.

Sheffield.—The *Sheffield Independent* for February 10th gives a complete copy of the terms of the agreement entered into by the Corporation and the Electric Light Company for the purchase of the undertaking, to which we briefly referred last week. The company receives £213 8s. for every £100 share originally invested, and in addition £70,000 for stock and stores in hand and recent capital expenditure.

It is stated that the solicitor acting in the interests of the Electric Light Company has forwarded a letter to the Town Clerk, stating that, having regard to the insinuations and untrue statements made at the last Council meeting, the directors have decided that the terms of purchase under discussion between the parties shall remain in abeyance for the present. The directors invite the Parliamentary Committee to inspect the minute books from beginning to end, and offer to supply all information with regard to the contracts, engagements, and liabilities of the company, in addition to full investigation of the figures mentioned in the terms of purchase.

The Parliamentary Committee, after considering the company's communication, expressed its opinion that the directors were fully acquitted of any improper secrecy or conduct in connection with the negotiations, and trusted that the terms would be accepted by the company.

Shrewsbury.—The provisional order has passed the standing orders of the Board of Trade, but a memorial has been lodged by six persons (all, or nearly all, large gas shareholders) against the purchase of the Shropshire Electric Light and Power Company's undertaking.

South Australia.—During the last session of Parliament in the colony of South Australia, an Act was passed in favour of the South Australian Electric Light and Motive Power Company, which gives to this company practically a monopoly of the electric light and motive power business throughout the colony. One of the promoters of the Bill was Mr. W. W. Crawford, M.I.M.E., C.H.E., A.I.E.E., the representative in Australia of Messrs. Johnson & Phillips, to whom orders for the Port Adelaide plant have already been transmitted. Mr. Crawford is a large stock holder, as well as a director of, and consulting engineer to the company. Messrs. Johnson & Phillips have now depôts at 91, Pitt Street, Sydney, and Brookman's Buildings, Adelaide.

Southampton.—The Electric Lighting Committee is to consider the subject of lighting the parks by electricity, in conjunction with the public thoroughfares. The plant is working to its full capacity, and no more consumers can be taken on until the end of May.

Taunton.—The Town Council will apply for a £10,000 loan for electric lighting extensions. Mains are to be extended in various parts, and a sub-station is to be erected at Rowbarton. The increased demand necessitates these extensions.

Mr. E. B. Thornhill, electrical engineer, reports that the lamp connections during the past quarter increased by the equivalent of 364 8-C.P. lamps, and orders were in hand for 480 8-C.P. lamps.

Torquay.—Trials are this week being made of the plant at the electricity works.

Wakefield.—The chairman of the Electric Light Committee visited Messrs. Fowler's Works at Leeds last week, and reported himself satisfied with the progress being made with the engines and dynamos, &c.

West Ham.—The Town Council has altered the rates of current from 6d. per unit for the first two hours and 4d. after, to 7d. per unit for the first two hours and 3d. after.

West Hartlepool.—The total amount of the electric lighting contracts given out, as stated under "Contracts Closed" last week, was £12,000. When the matter was before the Council, some members thought that the borough surveyor had not been consulted sufficiently in the matter, and that the recommendations of Prof. Kennedy should first have been submitted to him. However, the acceptance of the tenders was confirmed by the majority.

Weston-super-Mare.—The District Council is desirous of keeping the electric lighting business in its own hands, and the Weston-super-Mare Electric Light and Power Syndicate is also wishful in the same direction. The syndicate applied for an order annulling the powers granted under the 1891 municipal order, which had not been carried into effect. The Council drew up its objections to such a course, and expressed its intention of carrying out a scheme itself. Both parties have been in communication with the Board of Trade on the matter.

Wigan.—The Gas and Electric Lighting Committee is again going into the subject of electric lighting. At a recent Council meeting, Mr. Fyans made a long statement as to the progress being made in other towns.

Withington.—A sub-committee of the District Council has been appointed to enter into negotiations with the Manchester Corporation for a supply of electricity to the district.

Woking.—The Council complains that many of the electric lamps of the Woking Electric Supply Company give a light of less than 25 candle-power. A list has been sent to the company at its request.

Wood Green.—A letter from the Municipal Electric Supply Company, suggesting a supply of electricity for Wood Green, is in the hands of the District Council.

Worcester.—Statements were made at the City Council meeting recently, to the effect that the cost of electric lighting at the Market Hall was double what it was formerly for gas. In 1895 and 1896 the cost was £45 and £54 respectively for gas; but in 1897, for electric lighting, the cost was £112. It was stated to be the same at the Guildhall and Public Hall.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Airdrie-Coatbridge.—The Coatbridge Council has discussed the arrangements come to with the representatives of the British Electric Traction Company to lay this line of tramways, and has decided to withhold opposition provided certain concessions are granted by the company.

Australian Electric Power Scheme.—The *Times* correspondent at Melbourne telegraphed on 12th inst. saying that Messrs. Horn and Bakewell, two leading colonists of South Australia, had left by the *Orizaba* for London, to place the Great Western Railway and Electric Power Company before English capitalists. The company possesses valuable concessions of land, together with the right to construct a railway connecting Hobart with the Mount Lyell and Zeehan district, in Tasmania.

Bristol.—The Town Council has referred back to the Sanitary Committee its report upon the electric traction proposals of the Bristol Tramway Company. This report approved in principle the extensions of the company's system proposed, but suggested that certain routes might be altered with advantage. It, however, pointed out that the new lines were 7½ miles in length, and for half the distance there was not the requisite width of carriage way, 9 feet 6 inches, between the rail and kerb, and many frontagers had objected. The point, however, to which the report took special objection was the endeavour of the company under their Electrical Power Bill to arrange the mode of traction with the Board of Trade without consultation with the Council. The report proposed that the Committee oppose both Bills, although meanwhile negotiating with the company. Opposition to this view was expressed in an amendment which, after much debate was carried by 36 votes to 29. "That the report of the Sanitary Committee and the two Bills of the Tramway Company, be referred back to the Sanitary Committee for negotiations; that meanwhile a petition be presented against the Electrical Power Bill, but that the consent of the Corporation be given to the promotion of the Extension Bill conditionally."

Canterbury—Herne Bay.—A Dover paper says that a movement is on foot in Canterbury for establishing an electric tramway service between there and Herne Bay. The two towns are at present connected by a 'bus service.

Cardiff.—The Electrical and Lighting Committee propose sending a deputation to the Continent to inquire as to what is the best system of electric tramways for Cardiff. The proposal was only carried by three votes to two, and we suppose the matter has yet to come before the Council.

Dublin.—Before Mr. Justice Murphy and a special jury in the Dublin Nisi Prius Court, on 7th inst., Mr. Robert Forrester claimed from the Dublin United Tramways Company £500 damages for personal injuries sustained. When the plaintiff got on the platform of a car it gave a sudden lurch and he fell off, sustaining a cut and becoming unconscious. Defendant company declared that the car was at a standstill when plaintiff fell off. Judgment for defendants.

A special meeting of the Corporation was held on Wednesday, for the purpose of dealing with the report of the sub-committee appointed to deal with the plans of the Tramways Company for the introduction of electric traction within the city.

Edinburgh.—It has been referred to a Committee to report upon the advisability of constructing an electric tramway from Preston Street *viâ* Dalkeith Road and Niddrie Road, to Joppa and Portobello, returning by Meadowbank and Waterloo Place. As Prof. Kennedy is being consulted on various other matters this, too, is to be laid before him.

Electric Power Distribution Schemes.—Several of the other municipal authorities whose districts are affected by the two electric power schemes which have been occupying a good deal of attention of late, have resolved to oppose the proposals.

Electric Railway between Frankfort, Homburg, and Saalburg.—The Light Railway Company, Leuz & Co., of Stettin, has submitted to the municipal authorities at Homburg a project for constructing an electric railway, running from Frankfort-on-the-Main, through Homburg and Dornholzhausen to Saalburg. It is proposed in this scheme to run the line along the highways wherever possible.—*Elec. Tech. Zeit.*

Electric Railway between Glauchan, Meerane, and Crimmitschau.—The preliminary work for the construction of this electric railway has been commenced. The main line will run through the streets and highways to Crimmitschau; a branch line going from an intermediate station (Deunheritz) to Meerane.

Electric Tramways at Frankfort-on-the-Oder.—The electric street railway, built by the Allgemeine Elektricitäts-Gesellschaft at Frankfort-on-the-Oder, was opened on January 22nd.

Electric Tramways at Liegnitz.—These tramways, constructed by Felix Singer & Co., were taken over by the local authorities on January 18th, and were opened a few days later with 14 motor tramcars running on the line.

Egypt.—The Compagnie des Tramways d'Alexandrie has just secured a concession for another electric tramway in Alexandria, which will bring up the length of the electric tramways in that city to 25 kilometres.

Halifax.—Owing to the difficulty experienced in obtaining prompt delivery of materials, it is said to be very doubtful whether the whole of the system will be ready to be opened, as desired, on Easter Monday. The Electric Supply Association, however, have promised to supply sufficient plant and rolling stock to enable the Corporation to have at least one section of the tramways in operation by that date.

Hounslow.—Mr. Clifton Robinson appeared before the Hounslow District Council on 8th inst. and explained the details of the proposed electric tramway scheme which would touch this district. The Council, after discussion, gave its consent to the scheme, subject to certain conditions being fulfilled.

Introduction of Electric Traction in Berlin.—After the Berlin Horse Tramway Company received permission from the authorities to introduce electric traction, they set about the work immediately. In the first week of January the erection of the overhead conductor was begun, and by the middle of February the electric system will be working on lines from Alexander Platz to Schöneberg, and from Demminer Strasse to Kreuzberg. On these lines the mixed system of overhead conductors and accumulators will be employed. The overhead system on the first mentioned line will extend from Alexander Platz to Spittelmarkt at one end, and from Potsdamer Platz to the terminus at the other end. On the second mentioned line it will extend over the Demminer Strasse-Kreuzberg section, and the Bärwaldstrasse-Kreuzberg section. Electric traction will next be introduced on the Ringbahn, the conversion taking place early this year. On the lines from Lützow Platz and from Moabit to Charlottenburg, horse traction will be retained until October 1st this year. Permission has been given to the street tramway company to introduce electric traction before October 1st, 1898, an extension to January 1st, 1899, being granted if necessary. The company will not, however, be able to introduce as many accumulator cars as they require before October 1st, 1898.—*Elec. Tech. Zeit.*, January 6th, 1898.

Leeds.—The Leeds Tramways Company have, says *Daily Tenders*, adjourned for one month the question of providing the Headingley, Chapletown and Hunslet sections with a system of electric traction similar to that at Roundhay Park and Kirkstall.

Thirteen out of the twenty-two cars ordered for the Kirkstall-Roundhay electrical tramway are now running. This number of cars permits of a 10 minutes' through service. When the whole 22 cars are ready, there will be a 5 minutes service between Harehills Lane and the Cardigan Arms.

River Plate.—In December last "La Capital" electric tramway was inaugurated at Buenos Ayres. The length of line opened, says the *Review of the River Plate*, was 14½ kilometres, which will bring the suburbs of Flores and Caballito into direct communication with the southern and central districts of the city. The electric cars start from the Plaza at Flores, running to the temporary terminus at the corner of San Juan and Entre Rios, from which point passengers are conveyed in horse cars to the Plaza de Mayo, Boca and Darsena, combination tickets of the Capital Company being issued for the whole journey. The conversion to electricity of the existing line, between Entre Rios and Plaza de Mayo, is being actively carried on and will in a short time be completed, when a direct electric service from the Plaza de Flores to the Plaza de Mayo, and *vice-versa*, will be definitely established. The electric service from the Plaza de Mayo to the Boca will be opened early this year. The central terminus of the system is in the Plaza de Mayo, between Congress and the Government Houses, opposite the Bolsa, from which point the cars will proceed down Calle Victoria. The power station is at the corner of Comercio. The building covers 1,400 square metres, and is equipped with three vertical compound Ball and Wood engines of 450 H.P. each, directly coupled to 300 kilowatt Walker generators. Two of these units will be sufficient to supply current to all the cars that will be in operation on the line at one time, so that one unit can be kept in reserve. The engines have 30 inches × 14½ inches cylinders × 18 inches stroke, running at 175 revolutions per minute. They are fitted with Corliss valves placed in the cylinder heads. The admission valves are controlled by a Ball & Wood governor. There are four Stirling water-tube boilers of 250 H.P. each working at 140 lbs. pressure. Green's economisers and Conover's condensers with compound pumps are employed. The water system is very completely arranged. There are two Worthington pumps, either of which can supply all the water required by the four boilers. By means of a special system of piping either or both of the pumps may do the following service:—(1) Draw water from the city water service, (2) from a semi-artesian well, (3) from a large reserve water deposit, (4) from a waste water well. The water can be discharged (1) into the boilers direct, (2) into the boilers through the economiser, (3) the waste water into the sewer, (4) through a fire hose conveniently located in the boiler room. The power house is of steel, and is designed for an ultimate capacity of 20,000 H.P. Current from the power station is carried by an underground cable to Entre Rios, and then by trolley wires and a feeder cable overhead carried on poles. The return current from Entre Rios is also by underground cable, temporarily. The rolling stock will consist at first of 41 cars; and workshops for mechanical repairs, &c., have been erected. The cars will carry 52 passengers, 30 outside, 22 inside. They are equipped with two "General Electric 1,000" motors each. The entire rolling-stock has been built by the J. G. Brill Co., and mounted on Brill trucks, having been put together and painted in the tramway company's workshops. The track construction is most substantial. Johnson 9-inch 90-lb. grooved girder rails have been used, the rails being bonded with two classes of bonds, the Edison-Brown plastic bond, and the Syracuse soldered bond, and cross-bonded with copper wire every 100 metres. The feeders in the business districts are all underground. The poles are both wooden and iron, the latter being supplied by Morris, Tasker & Co., the H. W. Johns Company supplying the overhead appliances. Mr. Charles R. Thursby, managing director, superintended the construction of the line, and Mr. J. W. McCrosky is the chief engineer.

Staffordshire.—The Brierley Hill Council has approved the design submitted by the British Electric Traction Company for the trolley pillars for the electric tramways, subjected to the satisfaction of the surveyor.

Storage Batteries as Station Auxiliaries.—The Consolidated Traction Company, of Pittsburg, has recently installed two sets of storage batteries as station auxiliaries, one in one of its power stations, and the other at a point midway between the other three power stations; each set has a capacity of 500 ampere-hours. The result has been a considerable increase in the output of the stations; in a particular instance one set of accumulators in parallel with a 800-kw. generator, has enabled the company to obtain from this generator continuously for 24 hours an output of 1,100 kw. The total output of the four stations can be easily adjusted by means of accumulators, so that any one can be made to carry any portion of the load up to its capacity, the four stations are tied together by feeders; the actual economy in the resistance loss in the feeders by maintaining the voltage constant is very large. The results secured on this line have been so important that the United Traction Company has decided to abandon its present McKeesport station and substitute for it a storage battery station; the maintenance of this station has cost the company, on an average, about $7,200 per annum, most of which, it is thought, will be saved by the installation proposed.—*Electrical World*, New York.

Storage Battery Traction.—The equipment of the Ostend railway is on the electric accumulator system, the plant being established in the depôt of the local railway. The line, which was recently described in *L'Electricien*, is 3·1 kilometres long, and is virtually a circular road connecting the Kursal Boulevard, Rogier Station, and the Harbour. The plant includes one compound engine direct-connected to a Westinghouse dynamo, generating 135 amperes at 280 volts, and operating at 650 revolutions. The switchboard is of three white marble sections, with the usual instruments, and commands four accumulator-charging circuits with pressures varying between 240 and 270 volts. The charging of the accumulators is done upon a central track, so that the handling, both loading and unloading, is extremely easy of accomplishment. The complement of each car comprises 12 boxes of nine elements, having a capacity of 140 ampere-hours, at a 50-ampere rate. The charge lasts from three-quarters of an hour to two hours, according to the demand made upon the battery. As constant use gradually disintegrates the active matter of the positive plates, this is carefully saved in a tank, and eventually used for renewing the battery. This process is several times repeated before the frame finally becomes worthless, when it is recast. Each element is contained in an ebonite vessel, the nine elements being inclosed in a wooden trough, having two bands of copper for contacts. The carriages weigh 7,500 kilogrammes without accumulators or passengers, and have a capacity of 24 seats and 26 standing places. They have no imperial or deck seats. The carriages are lighted by six 16-candle-power lamps each, and are provided with two 18-kilowatt Westinghouse motors, each connected to an axle by reducing gears of one to five. The motors are regulated by a series-parallel controller with spark extinguisher. According to data obtained for three months of active service, the management claims that the expense of this line will be very much below anything so far known in this form of traction, the consumption of coal being shown to be but 1·45 kilogrammes per kilometer-car.

Stourbridge and Kinver Electric Railway Scheme.—On Tuesday, the Earl of Jersey and Col. Boughey, the Light Railway Commissioners, held an inquiry at Stourbridge respecting the proposal of the British Electric Traction Company to construct an electric tram line between Coalbournbrook and Kinver. Mr. Foley, one of the principal landowners had intended to oppose the railway, but he withdrew his opposition during the inquiry. In the result, Lord Jersey said that as regarded the preamble there was a case, and the Commissioners would be happy to recommend to the Board of Trade

that the order should go forward. He, however, pointed out that many difficulties might have arisen had Mr. Foley not withdrawn his opposition so handsomely.

Sydney.—Mr. G. Fischer, an officer of the Works Department, recently returned from the United States, where he had been superintending the construction of some electric material for the George Street tramway. A Sydney paper says that the material that has been ordered for the department from the States is for the power-house at Ultimo. The department is also getting from the States 2,000 tons of steel rails. An effort was made to obtain the rails from England, but manufacturers there found it impossible to supply them with the higher proportion of carbon that was required. American firms, however, promptly agreed to provide the material of the desired quality, and the order was placed accordingly.

Swansea.—The Swansea Tramway Company, which has been negotiating for some years with the Swansea Corporation, have, says the *Western Mail*, now practically come to terms with another customer for the undertaking. A meeting of shareholders is to be held in London on February 25th for the purpose of considering the terms of an agreement, dated February 9th, 1898, between the Swansea Improvements and Tramways Company, and the British Electric Traction Company, for the sale of the undertaking, property and assets of the Swansea Company to the Traction Company.

Switzerland.—The Authorities of the Zurich Municipal Electric Tramways have just invited tenders for the supply of additional plant, including 24 motor tramcars, required in connection with the extension of the tramway system.

TELEGRAPH AND TELEPHONE NOTES.

A Bright Outlook.—We make the following extract from the *Outlook*, to which new periodical we offer our best wishes for a successful career:—"The commercial battles of the future will beyond a doubt be waged in the Pacific. England, the United States, Canada, Australia, Japan, Russia, and now Germany and France—in a word, all the great trading nations—are preparing for the struggle. What is England doing to meet the future? What, indeed! She has in the Canadian Pacific Railway an Imperial highway of the highest strategic and commercial importance; but that thread of empire Canada herself provided, without one cent of cost to the British taxpayer. Canada, too, has spanned the Pacific with mail and trade services to China and Japan on the one hand, and Australasia on the other, some of the Australasian colonies helping in the latter case. Is it too much to ask that England should follow up this spirited colonial lead by really doing something in the matter of the Pacific cable? Why allow it to be any longer the sport of committees and sub-committees in Downing Street? It is a great and pressing need in the interests of England, Canada and Australia alike, and in view of all that is happening in the Pacific, should be dallied over no further."

The Telephone Service.—The National Telephone Company has communicated with the Corporation, asking for a conference on the telephone question. This is in consequence of the City's decision to hold an inquiry. It is stated that the late Commission of Sewers many times invited the company to confer on the matter, but no notice was taken of the application.

The difference existing between the General Post Office and the Commission of Sewers, in respect of the laying of lines of underground telegraphs under certain City streets, came before the Railway and Canal Commission (Mr. Justice Wright, Sir F. Peel, and Viscount Cobham) on Thursday last week. The case was before the City of London Court in December (see ELECTRICAL REVIEW, December 3rd), when Mr. Commissioner Kerr decided the case in favour of the Post Office. The City Corporation appealed to the Railway Commissioners, contending that the order was not reasonable or just. After the speeches of counsel, Mr. Justice Wright said that the Corporation, in seeking to restrict the consent given to the Post Office, had no doubt been actuated by no captious or unfriendly spirit, but had striven to give effect to their view that when companies were making a profit by using public streets for private purposes, they should be compelled to give good value in return for concessions allowed to them. The question, however, arose as to whether they had the right of control which they claimed. Even if it were open to them to seek to impose such conditions as were in question in this case, the Court were of opinion that they were not reasonable, and would, according to the terms of the Act, "consent" that the streets should be opened by the Post Office authorised under the conditions usually imposed in such cases. Judgment was accordingly given for the Postmaster-General, without costs.

The Boston Town Council wishes the Post Office to bring its trunk lines to Boston, and also has in mind a scheme for a municipal local service.

In the House of Commons last week, Mr. Provand asked the Secretary to the Treasury what were the working expenses of the intertown telephones, and how much the intertown wires had earned since the date on which they were taken over from the National Telephone Company to December 31st, 1897. Mr. Hanbury replying, said that the capital expenditure—partly estimated—to December 31st, 1897, was £1,190,000. This sum includes the amount paid to the National Telephone Company. The gross earnings up to the same date amounted to £200,832. The working expenses, being included in those of the telegraph service, cannot be separately stated.

French Telegraph Extension.—The French Minister for the Colonies states that telegraphic communication is established between Senegal and Waguadougo, and will soon be extended to Fada-n-gourand.

German Telephones.—The German Imperial Post Office authorities have resolved to henceforth supply only single-receiver instruments for business or house telephone connections. A second receiver may, however, be obtained for 10s. from the post office authorities, who will maintain it for a certain sum. An annual payment of 5s. will be required from those subscribers already having double receivers, but the latter instruments will not again be issued for public use.

The Glasgow Telephone Inquiry.—The *Scotsman* learns that a demand is to be made on the Treasury for the production of Sheriff Jameson's report on the Glasgow telephone service. Mr. Hanbury will in the first place be privately approached, and, in the event of a refusal, the matter will be brought forward in the House.

Huddersfield Telephones.—The Postmaster-General has refused the application for a municipal telephone license, and the Council has dropped the proposal. A sub-committee is to consider terms of agreement with the National Telephone Company with regard to their application to lay wires underground.

Interruptions to Australian Land Lines.—In the formidable list which we published last week of interruptions of the trunk land lines of Australia, on which we rely for communication to the principal centres of that continent, we omitted to note that on December 9th last the West Australian land line, which joins a submarine cable to Java at Roebuck Bay was interrupted, and, as from the 8th till the 12th the South Australian land line, which runs from Adelaide in the south to Port Darwin in the north of Australia, was also broken down, it follows that Australia was completely isolated on December 9th, apart from the general delays on the 8th, 10th, 11th and 12th of that month, owing to the breakdown of the Port Darwin line. In addition to last week's list of interruptions, we have now to add that, on the 9th, current communication with Adelaide ceased, and, we learn from the *Times* of the 11th, that telegrams from Sydney were not received owing to the interruption of South Australian land lines. Since that date there has been a more or less spasmodic supply of telegrams from Australia conscientiously marked "delayed in transmission." Thus altogether, during the last five months, there have been at least 15 or 16 cases in which the trunk land lines in Australia have been broken down. In view of this, we can only admire the temerity with which the Eastern Telegraph Company proposes to land still another cable in West Australia, which of course will, just as much as the existing cables, have to depend on the very intermittent land line service under review for the transmission of telegrams to the principle centres of population on the south-east and east coasts of Australia. Although not affecting the land lines in that country, we learn from the Australian press that on December 1st last "the delay to the outward traffic from London is due to messages being diverted from the Indo-European line."

The Telegraph Wire Export Trade.—January has proved to be a very dull month as regards the exports of telegraph wire and apparatus connected therewith, from this country. In former years the January exports have usually fallen a long way short of those of the preceding month, but this year the decrease is much greater than usual, from £172,140 in December, 1897, to only £37,929 last month, the figures for January, 1897, being £62,120.

Telegraphic Addresses.—In the Commons the other day Mr. Hanbury, replying to Sir C. Cameron, said:—It is the fact that the rule of the Post Office that the first word in an abbreviated address must be a dictionary word containing not more that 10 letters, and that proper names and compound words—*i.e.*, words which appear in a dictionary joined by a hyphen—can only in rare cases be accepted, is intended, as the hon. member supposes, to preclude the registration of arbitrary words consisting of 10 letters, or constructed from the first and last syllable of a firm's name, or spelling the initials of the designation of a club, unless, indeed, these syllables or initials happen to make a real word.

Telegraphic Interruptions and Repairs:—

CABLES.	Down.	Repaired.
Brest-St. Pierre (Anglo, 1869)	April 6th, 1893 ...	...
West Indies—		
St. Croix-Trinidad ...	Nov. 30th, 1896 ...	...
Curaçao-La Guayra ...	Jan. 5th, 1898 ...	Feb. 15th, 1898.
Paramaribo-Cayenne ...	Jan. 27th, 1898 ...	...
Amazon Company's cable—		
Parintins-Itacatiara ...	May 5th, 1896 ...	...
Obidos-Parintins ...	Dec. 7th, 1896 ...	...
Saigon-Hong Kong	Jan. 8th, 1898 ...	...
Bolama-Bissao	Jan. 28th, 1898 ...	Feb. 14th, 1898.
Emden-Vigo	Feb. 7th, 1898 ...	...
Cyprus-Latakia	Feb. 10th, 1898 ...	...
LANDLINES.		
Trans-Continental line beyond Masol	March 12th, 1896 ...	...
Cartagena-Barranquilla ...	July 4th, 1896 ...	...
Nicaragua landlines	Feb. 8th, 1898 ...	Feb. 10th,
Costa Rica "	Feb. 10th, 1898 ...	...

CONTRACTS OPEN AND CLOSED.

OPEN.

Bilbao.—February 28th. The Secretary of State for Foreign Affairs has received a despatch from Her Majesty's Consul at Bilbao, reporting that the provisional board appointed in connection with the electric tramway which it is proposed to lay from Zumarraga to Zumaya, in the province of Guipuzcoa, invite plans and tenders, to be received by February 28th, for the construction and equipment of the line. Further particulars of the conditions of the tenders for the above-named tram line and branch, which together measure 30 miles, may be inspected at the Commercial Department of the Foreign Office any day between the hours of 11 and 6.

Belfast.—March 8th. The Corporation wants tenders for the wiring of the new police cells, Chichester Street. Electrical engineer, Mr. V. A. H. McCowan. See our "Official Notices."

Berlin.—March 15th. The Municipal Traffic Deputation of the Town Council has opened a competition for the construction of several new electric tramways in that city. Exhaustive details concerning this project are contained in the *Elektrotechnische Zeitschrift* of the 13th inst., which mentions that proposals will be received by the Stadtische Verkehrsdeputation Rathhaus III, Berlin, by March 15th.

Bristol.—February 21st. The Electrical Committee wants tenders for 214 arc lamp posts. Electrical engineer, Mr. H. Faraday Proctor. See our "Official Notices" February 11th.

Canterbury.—February 23rd. Tenders are invited for the electric wiring and fittings for the Beaney Institute for the Town Council. Specifications, &c., to be obtained at the office of the City Surveyor, 28, St. Margaret's Street.

Carlisle.—February 25th. Tenders are being invited for the erection of the central station buildings in James Street. City engineer and surveyor, Mr. H. C. Marks, 36, Fisher Street.

Coventry.—March 8th. The Electric Light Committee wants tenders for the supply and erection of engine house, separate exciting and surface condensing plant, also pipework, switchboards and instruments for extensions of the municipal electricity works, Consulting engineer, Mr. Robert Hammond. See our "Official Notices" this week.

Denmark.—March 12th. Tenders are being invited for the supply of the engines, dynamos, accumulators, &c, required in connection with the new central station at Frederiksberg, near Copenhagen. Tenders to be sent to the Frederiksberg Sporveis-og Electricitets Aktieselskab, Gammel Kongerie, 140, Copenhagen V., from whom particulars may be obtained.

France.—March 31st. Tenders are being invited by the Municipal Authorities of Saint Chamond (Loire) for the concession for the lighting of the public streets of the town, either by gas or electricity. Particulars from, and tenders to be sent to, La Mairie de Saint Chamond (Loire).

Glasgow.—February 28th. The Corporation wants tenders for the hire or purchase of dynamos and engines, direct coupled or belt driven, capable of providing 1,100 break H.P. and spare power equal to 25 per cent. additional, also two rope driven dynamos to run at a speed not exceeding 500 revolutions per minute, and capable of providing 200 H.P. each at a potential of 230 H.P. The plant must be delivered by August 1st. Engineer, Mr. W. A. Chamen. See our "Official Notices."

Glasgow.—February 28th. The Corporation wants tenders for the supply of lead covered cables and accessories for twelve months, accumulators, motor transformers, motor driven boosters and switching apparatus. Mr. W. A. Chamen, engineer. See our "Official Notices."

Harrogate.—February 24th. The Corporation invites tenders for the supply and erection of vertical steam engine, dynamo, switchboard, motor, overhead conductors, &c., for sewage pumping plant. Mr. Geo. Wilkinson, borough electrical engineer. See our "Official Notices" February 11th.

Italy.—March 2nd. Tenders are being invited by the Municipal Authorities of Piacenza for the establishment of a central electricity generating station in the town for lighting and power purposes. Particulars may be had from, and tenders to be sent to, El Municipio di Piacenza, Italy.

Liverpool.—March 8th. The West Derby Board of Guardians wants tenders for supply and erection of boilers, engines, dynamos, batteries, wiring, &c., for the lighting of the Mill Road Infirmary. Consulting engineer, Mr. T. L. Miller. See our "Official Notices" for particulars.

Madrid.—February 22nd. The Secretary of State for Foreign Affairs has received a despatch from Her Majesty's Chargé d'Affaires at Madrid, enclosing copy of a Royal decree announcing that a public auction for the contract for repairing the national submarine telegraph cables during the next five years will be held at Madrid on February 22nd. Further particulars as to the cables in question may be inspected at the Commercial Department of the Foreign Office any time between the hours of 11 and 5.

Northwich.—March 5th. The Weaver Navigation Trustees are inviting tenders for the construction and erection of the necessary electric power plant for lighting and working the new swing bridges at Northwich. Current will be supplied by the Northwich Electric Supply Company. Engineer, Mr. J. A. Saner, M.I.E.E. See our "Official Notices" February 11th.

Pembroke (Ireland).—March 5th. The Lighting Committee wants tenders for the supply and erection of various plant, machinery, &c., for electric lighting. See our "Official Notices" this week for full particulars. Consulting engineer, Mr. Robert Hammond.

Plymouth.—February 21st. The Council wants tenders for the erection and completion of a refuse destructor with all necessary flues, fittings, boilers, &c. Borough engineer, Mr. James Paton, Municipal Offices.

Portsmouth.—February 22nd. The Corporation wants tenders for the supply and erection of Lancashire boilers, feed pumps, mechanical stokers, &c. Consulting engineers, Messrs. Kincaid, Waller & Manville. See our "Official Notices" February 11th.

Rochdale.—February 19th. The Corporation wants tenders for steam dynamos, balancer, and boosters, &c. Engineers, Messrs. Lacey, Clirehugh & Sillar. See our "Official Notices" January 14th.

Roumania.—March 15th. Tenders are being invited by the General Direction of the Roumanian Post and Telegraphs in Bucharest for the supply of 56,000 metres of galvanised iron and steel wire.

Shoreditch.—March 8th. The Vestry wants tenders for the supply of electric cables and sundries, also engineers' tools, ironmongery, &c. See our "Official Notices."

St. Helens.—February 21st. The Corporation wants tenders for various plant and machinery, &c., in connection with the proposed electric tramways. See our "Official Notices" January 28th for particulars. Consulting engineer, Dr. J. Hopkinson.

St. Pancras.—February 22nd. The Vestry wants tenders for dry back marine boilers with superheaters and brickwork seatings. See our "Official Notices" February 4th.

Sunderland.—February 25th. Tenders are invited by the Corporation for the supply of various cables, pipes, service boxes and stoneware casings for the year. Borough electrical engineer, Mr. J. F. C. Snell. See our "Official Notices."

The War Office.—April 27th. The Secretary of State for War is prepared to receive offers, competitive designs and specifications for the supply of portable electric search light apparatus. Particulars from the Director of Army Contracts, War Office, Pall Mall, S.W. See our "Official Notices" February 4th.

Victoria.—March 21st. The Telegraph Department of the Victorian Government Railways is inviting tenders for the supply of alternating current transformers and one main switchboard. Tenders to the Telegraph Superintendent's Office, Spencer Street, Melbourne.

Wallasey.—March 17th. The District Council wants tenders for the supply of engine, alternator, exciter, two Lancashire and one water-tube boilers, and condensing apparatus. Engineer, Mr. J. H. Crowther. See "Official Notices" February 11th.

Watford.—March 16th. The District Council wants tenders for the supply and erection of various plant for the electric lighting of the district. For details of the seven sections see our "Official Notices" February 11th. Mr. W. C. C. Hawtayne, consulting engineer.

West Ham.—March 8th. The Council invites tenders for wiring and fitting up various buildings, including the Town Hall, police court, Corporation stables, fire stables, &c. Mr. J. Steinitz, borough electrical engineer. See our "Official Notices" this week.

CLOSED.

Aberdeen.—The contract for the supply of a 650-H.P. engine and dynamo (£4,147) is being given to Messrs. Mather and Platt, Limited, £60 extra being paid for adapting it for traction work.

Belfast.—The Harbour Commissioners have accepted the following tenders for the supply of electrical plant for the extension of the electric lighting of the quays at the Harbour:—

Dynamos (two)	Mr. Wilson Hartnell
Switchboard and switches	Williamson & Joseph
Arc lamps	Mr. C. A. Müller
Lamp posts	Mr. T. Scott Anderson
Mains, boxes, &c.	British Insulated Wire Company

Bootle.—The Town Council has accepted the following tenders:—

Contract No. 1.—Boilers and economisers	T. Parker, Limited, at £11,791, less £680 allowance for present engines, dynamos & switchboards.
„ „ 2.—Engines, dynamos, &c.	
„ „ 4.—Feeders, mains, service lines, &c., and maintaining same for 10 years	£10,096.

„ „ 5.—Messrs. T. Parker, Limited, for the running of electricity supply works and supply of current for public and private purposes as follows:—For each 10 ampere arc lamp run from one hour after sunset to one hour before sunrise (3,620 hours per annum), £24 per annum; for each 10 ampere arc lamp run from one hour after sunset to midnight (1,810 hours per annum), £12 per annum; for each lamp hour added or deducted from above, 1·55d.; for each incandescent lamp used for public lighting, 3d. per unit; for remainder of current up to guarantee of 100,000 units per annum for public and private purposes, 3·75d. per unit; for first 25,000 units above guarantee, 1·75d. per unit; for second 25,000 units above guarantee, 1·25d. per unit; for every unit in excess of 150,000 units, 1d. per unit.

The question was raised by some Councillors as to why the tender of a local firm had not been accepted. Councillor Hall replied that the acceptance of the local tender would have meant a loss to the ratepayers of £4,700 in three years.

Bradford.—The City Council has accepted tenders as follows for electric lighting plant:—

Two dynamos.—Siemens Bros. & Co., Limited	£2,800
(Extra armature)	600
Two 600-H.P. steam engines.—Willans & Robinson	4,590

A sub-committee is to inspect combined lighting and traction central stations on the Continent.

Burnley.—The Corporation has accepted the tender of Messrs. G. E. Belliss & Co., for two combined engines and dynamos for electric lighting extensions at £4,888.

St. Pancras.—The Vestry has accepted the tender of the Fowler-Waring Cables Company (£4,196 odd) for cables, &c., for the extension to Queen's Crescent, Malden Road and Prince of Wales Road.

Wimbledon.—The following tenders have been accepted in connection with the Council's electric lighting scheme (Mr. A. H. Preece, consulting engineer):—Buildings, Burgess £3,388. Boilers, Babcock & Wilcox £2,482. Steam engine and dynamo, Crompton and Co. £4,181. Mains, W. T. Henley's Co. £15,792. The switchboard, condenser, and crane contracts have not been finally decided yet.

FORTHCOMING EVENTS.

1898.

Friday, February 18th, at 6.30 p.m.—Institution of Electrical Engineers. Students' visit to the generating stations of the St. Pancras Vestry.

Finsbury Technical College Conversazione. Lecture on "Wireless Telegraphy," by Dr. S. Thompson.

At 7.30 p.m. Staff smoking concert of the City of London, the Metropolitan, and the London Electric Lighting Companies, at the Crown Room, Freemason's Tavern, Great Queen Street, Holborn, W.C. Chairman, Mr. P. W. D'Alton.

Saturday, February 19th.—Latest date for the Rochdale Corporation electric lighting tenders.

Monday, February 21st.—Latest date for Bristol Corporation arc lamp posts tenders.

Latest date for the St. Helen's Corporation electric tramway plant tenders.

Whitehall Rooms of the Hôtel Métropole. Webb Testimonial presentation reception at 9.30 p.m. Presentation at 10 o'clock p.m.

Tuesday, February 22nd.—The Federated Institution of Mining Engineers, 26th general meeting at Newcastle-upon-Tyne. Various papers are to be read, and among those to be open for discussion are the following:—"Light Railways," by Mr. Leslie S. Robinson. "A One-rail or Trestle System of Light Railway," by Mr. Fred. J. Rowan. "On Some Dangers attending the Use of Steam Pipes," by Mr. A. L. Steavenson. "Machine Coal-mining in Iowa, U.S.A.," by Mr. H. Foster Cain. "Latest Developments and the Practical Application of Alternating Multiphase Machinery for Power Transmission," by Mr. Walter Dixon. Visits will be paid to the Telegraph and Telephone Departments at the General Post Office, Mr. A. W. Heaviside, Superintending Engineer.

Latest date for St. Pancras tenders.

At 8 p.m.—Institution of Civil Engineers.—Papers to be read with a view to discussion: (1) "The Theory, Design and Working of Alternate Current Motors," by Mr. Ll. B. Atkinson, Assoc.M.Inst.C.E.; and (2) "The Dublin Electric Tramway," by Mr. H. F. Parshall, M.Inst.C.E.

Latest date for the Portsmouth electricity supply plant tenders.

Wednesday, February 23rd.—Second day of the Federated Institution of Mining Engineers. Various excursions, including visit to the works of Ernest Scott & Mountain, Limited, Newcastle-on-Tyne.

Latest date for the Canterbury Council wiring tenders.

Thursday, February 24th.—Latest date for tenders for Harrogate Corporation electrical plant for sewage pumping.

At 8 p.m.—The Institution of Electrical Engineers. "On the Manufacture of Lamps and other Apparatus for 200 volts Circuits," by G. Bischwanger-Byng.

Friday, February 25th, at 6.30 p.m.—The Institution of Electrical Engineers. Students' visit to the Shoreditch electricity supply station. Applications at once to the Students' Hon. Sec. (Mr. S. Grant, 28, St. Mary Abbot's Terrace, W.) as the number will be limited to 20.

At 8 p.m.—The Institution of Civil Engineers.—Students meeting. "The Problem of Train Resistance," by C. E. Wolff, B.Sc., Stud.Inst.C.E.

Saturday, February 26th, at 4 p.m.—Physical Society in the Chemistry Lecture Room, Keate's Lane, Eton College. The Rev. T. C. Porter will describe:—1. A new theory of geysers. 2. A new method of viewing Newton's Rings. 3. Experiments bearing on the sensation of light. 4. A method of viewing lantern projections in stereoscopic relief. 5. Winter observations on the shadow of El Teide, with a new method for measuring approximately the diameter of the earth. 6. Temperature of the water of Niagara.

NOTES.

Correspondence.—We have received, just as we go to press, a letter from Mr. Robert Hammond, regarding the Shoreditch dust destructor, replying to the letters of Messrs. Kershaw and Russell, which appeared last week. We regret being compelled to defer publication until our next issue.

Postal Telegraph Factory Staff Dinner.—The staff of the Postal Telegraph Factory, Mount Pleasant, held their fourth annual dinner at the Inns of Court Hotel on Saturday, February 5th, Mr. Martin F. Roberts, the superintendent of the factory, presiding. Among the guests present were Mr. J. C. Lamb, C.B., C.M.G.; Mr. J. Ardron; Mr. H. C. Fischer, C.M.G.; Lieut.-Colonel P. G. von Donop, R.E.; Prof. W. H. H. Hudson, Dr. Mumford, Dr. Walmesley, Messrs. J. W. Eames, W. Slingo, W. V. Morten, and G. W. Hook. The occasion was the 28th anniversary of the acquisition of the telegraphs by the State, and in responding to the toast of "The Chief Office" (proposed by the chairman), Mr. Lamb dwelt upon the progress made in telegraph engineering, and in the general efficiency of the service to the public during the past 28 years. A hope was also expressed that, as many present had assisted at the transfer of the telegraphs in 1870, so, also, many would live to see complete success attending the efforts now being made to render the telephone service equally efficient. In proposing the toast of "Electrical Engineering," Mr. A. Brooker emphasised the importance of the pioneer work done by telegraph engineers, which rendered possible the rapid progress in other more modern branches of electrical engineering, and mentioned that the running of two properly designed alternators in parallel might be more exciting, but was certainly a far less difficult task than the running of two multiplex motors and distributors for eight hours synchronously. In the absence of Mr. W. H. Preece, Mr. J. Ardron responded. Mr. J. M. G. Trezise proposed "The Guests," and referred to the long and remarkable career of Mr. H. C. Fischer, and to the acknowledged efficiency of the Royal Engineers, especially the Telegraph Battalion—a point upon which those present were well qualified to express an opinion. Mr. Fischer and Lieut.-Col. von Donop replied in felicitous terms, the latter acknowledging the advantages resulting from the close connection between the Engineers and the Postal Telegraphs. A varied vocal and instrumental musical entertainment was given during the evening by members of the staff.

Institution of Mechanical Engineers.—The 51st annual meeting of this Institution was held in the hall of the Institution of Civil Engineers, Great George Street, Westminster, on Thursday and Friday last week. The chair was occupied during the earlier portion of the proceedings by Mr. E. W. Richards, the retiring president, who introduced Mr. Edgar Worthington, the newly-elected secretary, to the meeting. The report stated that at the end of last year the number of names on the roll was 2,496, as compared with 2,359 at the end of the previous year. During 1897 227 names were added, the loss by death being 30, and by resignation or removal 60. The result of the ballot for the election of the council was announced, Mr. S. W. Johnson being elected president, and Mr. Arthur Keene and Sir William White vice-presidents. The discussion was afterwards resumed upon a paper read at the last meeting by Mr. Philip Dawson on "Mechanical Features of Electric Traction."

(*Continued on page* 227.)

THE MAKING OF CHLORIDE ACCUMULATORS.

(*Concluded from page* 188.)

The description of the manufacture of the chloride negative plate may be fittingly concluded by illustrating a complete cell showing plates, and this is given in fig. 6.

Comparatively speaking, the manufacture of the positive plate is a simple operation. Contrary to what occurs in making the negative plate, the positive grids are made first. They are cast in moulds by means of compressed air, as is done in the case of the negative plates. The material is antimonial lead, and the moulds are arranged to leave a series of holes in the frames, and into these apertures are pressed cores of lead. The core takes the form of a pure lead rosette, and the process of making this rosette is exceedingly interesting. First of all, long strips of pure lead, about ¼ inch in width, are passed through specially designed machines, which will rib and automatically cut it into short lengths. Fig. 7 gives a fair idea of this operation which is known as gimping; the gimped pieces are then collected and carried to adjoining tables, where the lengths are spun by boys into small rosettes (fig. 8). The rosettes are then pressed by hand into position in the plates, the process being indicated in fig. 9. When the plates are filled they are passed through a hydraulic press, which completes the keying of the rosette mechanically, the plate being then practically ready for forming. The formation is effected by coupling up the plates with a set of dummy negatives and passing the current continuously through the cells, the rosettes becoming finally coated with a fine adherent hard crystalline coating of peroxide.

After the formation process the plates are then cast up into sets in a similar manner to the negative. That practically completes the general outline of the manufacture of chloride plates. There are, of course, many details that could not very well find a place in this article, but probably sufficient has been said to indicate the general nature of the process.

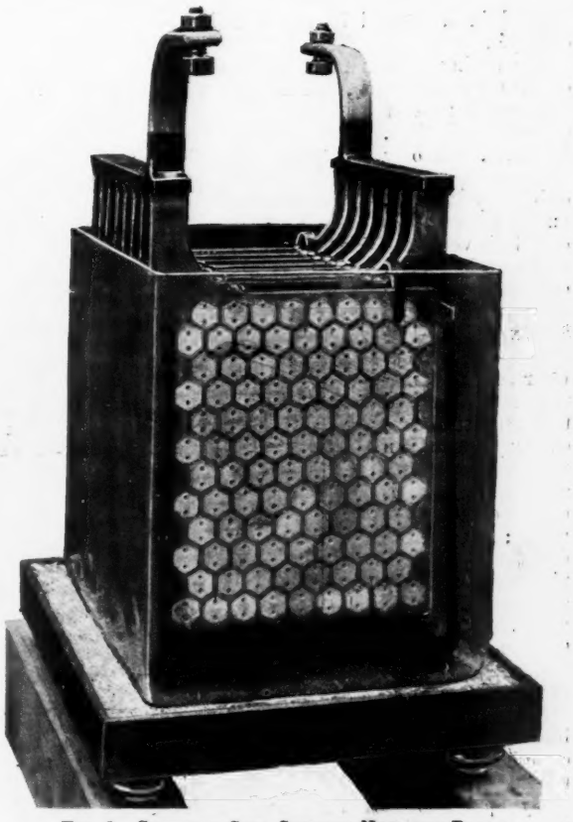


Fig. 6.—Complete Cell Showing Negative Plate.

Fig. 8.—Making the Rosettes.

There are many other things at these accumulator works that one ought to refer to. There is the electrical plant, which, in a way, is interesting, and consists of two 90-H.P. compound condensing engines, each directly coupled to a Mather & Platt multipolar dynamo; then there is a high-speed compound engine, coupled direct to a two-pole dynamo, also of Mather and Platt manufacture. In addition is a motor generator, which is capable of delivering current at 10 volts. The steam raising plant consists at present of two Lancashire boilers, though arrangements are being made for extending it. The generating plant is utilised not only for formation purposes, but serves to light the extensive works and to furnish energy for driving motors, which form quite a distinguishing feature of the place. There is nothing specially interesting about the switchboard. Each unit has a separate panel, and there are separate boards for controlling the energy used in the formation baths and in the lighting and motors. Housed in the same building as the generating plant is a large double-throw pump, which is used for the condensers, a double set of pumps for supplying the hydraulic accumulator, and also two Westinghouse compressors for the supply of compressed air.

There are, of course, the usual workshops necessary in such establishments. There is a large joiners' shop, equipped with modern machinery, and driven by electrical means. There is also a mechanics' shop, fitted with machine tools, and close by are the stores. It is very important that the workmen employed on certain sections of accumulator work should be kept moderately clean, and though we suppose it is not an easy matter to make a man clean by Act of Parliament, little trouble is experienced in this direction at the Chloride Works; moreover, the management insist that every man before he commences or recommences work shall have a substantial meal, and the enforcement of this rule has

resulted in a general improvement in the health of the employés.

The testing of accumulators forms a very important part of the work carried on, and a large room is set apart for commercial tests of every description. Moreover, not only is the chloride cell elaborately tested, but all known types of cell are very carefully scrutinised and compared with the home article. With the exception, as we have pointed out before, of purchasing raw materials and the glass boxes, every operation necessary to produce a chloride cell is carried out on these works; there is little doubt that for completeness, for facility and convenience of manufacture, the Chloride Works rank among the best in the country.

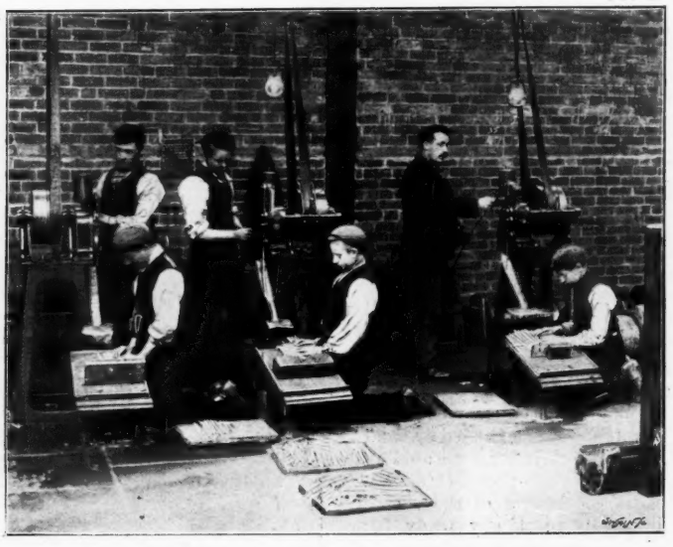


Fig. 7.—The Gimping of the Lead Strip.

Some allusion has been made to the directions in which the chloride cell is performing useful work; but perhaps the most interesting of its many applications is the use that is being made of the cell for traction work, both in conjunction with the overhead wire system, and in cases where the accumulator is carried on the car. As an auxiliary to the overhead system, the excellent service of the Chloride cell is not confined to this country. One of the most notable examples is the system of the Union Traction Company, of Philadelphia, which operates some 500 miles of road. In making recent extensions on this line, it was found that it would be necessary either to build a new power house, or instal a battery sub-station, as the required addition to the existing feeder system would necessitate such an enormous outlay for copper, as to render it commercially impossible. It was found that the cost of copper alone to carry out this extension, and double the service on the section, would be four or five times the total cost of a battery installation to fully meet all the requirements, and that a new power house was out of the question, on account of the heavy operating expenses. Before the extension was made, the pressure at the end of the feeder was barely enough to operate cars on schedule time, and the pressure varied as much as 50 per cent.

The load on the section varies from 100 to 700 amperes; the feeder carries a constant load of 400 amperes, the battery discharging or charging to the extent necessary to maintain this condition. The result in actual practice is found to be that the feeder load remains constant at this average current, and is absolutely independent of the fluctuating demand on the line. It is claimed that the battery in these cases enables the generators always to run at full load, and consequently at the highest point of efficiency, and to act as a cushion to the engine in the event of the circuit breaker opening when trouble occurs on the line.

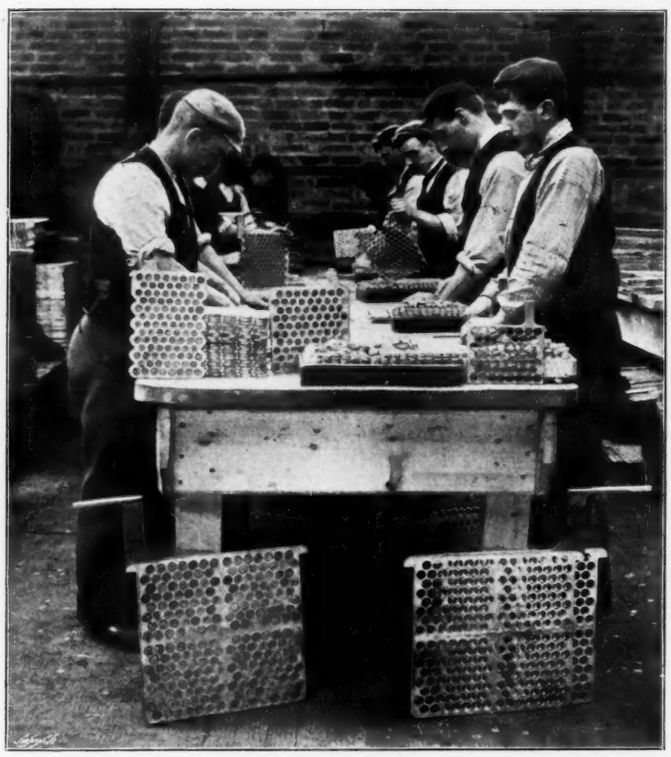


Fig. 9.—Pressing the Rosettes into the Positive Grids.

On the Woonsocket line they have been able to show in pounds, shillings and pence what the value of a battery is, and it has been found that the saving in operating expenses amounts to £700 per annum.

In this country it has been already demonstrated on the existing electric tramway systems that one of the most valuable functions of a storage battery is to provide a reserve in case of breakdown.

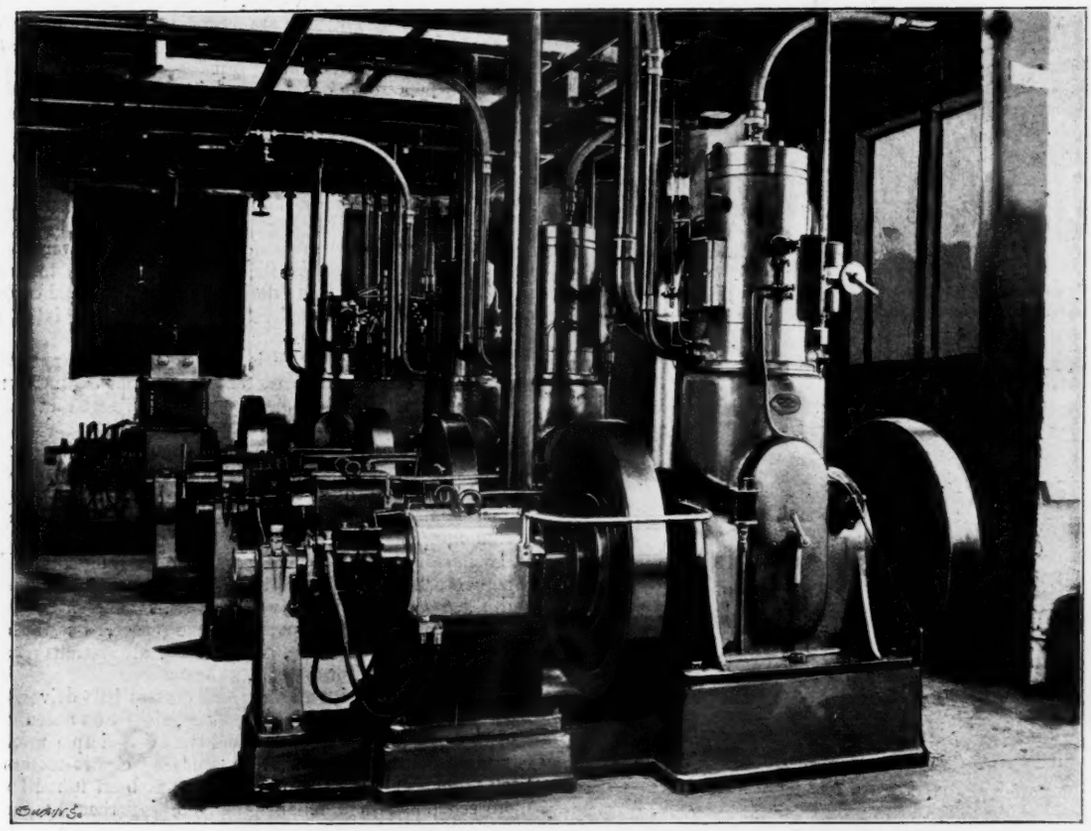
In accumulator car systems, the Chloride cell has established a good reputation; and is being used on four lines in Paris at the present moment. The working results of one of these systems was published in the Review some months ago. Even on the much maligned Central Tramway system, where these cells have now been used for three years, the record is a good deal better than is generally supposed; indeed, we are not exaggerating when we say that the cost of upkeep of the batteries does not exceed 1⅜d. per car mile.

The Americans were always fond of big things, but it was generally supposed in this country that, in the use of storage batteries for lighting, we should not have had to yield the palm to our American friends; yet the Chicago Edison Com-

pany are about to put down what is very properly termed the largest storage battery in the world, one that is costing £20,000.

GAS ENGINES FOR ELECTRIC LIGHTING.

It is generally admitted that the internal combustion engine will play a conspicuous part in the cheapening of electricity, but one must be forgiven if at times one thinks the progress made in gas engine construction seems to be a little slow. At the same time, there is abundant evidence that gas engines for electric lighting work have been materially improved during the past few years. They are not only giving less cyclical variation, but the economy of a modern gas engine shows a most marked advance on the performances of, say, four years ago. Compared with steam motors, the size of the gas engine is still insignificant, and the weight of material per effective horse-power is very considerable; but the one great drawback that was urged against gas engines for electrical work, namely, unsteady running, may be said to have completely disappeared.



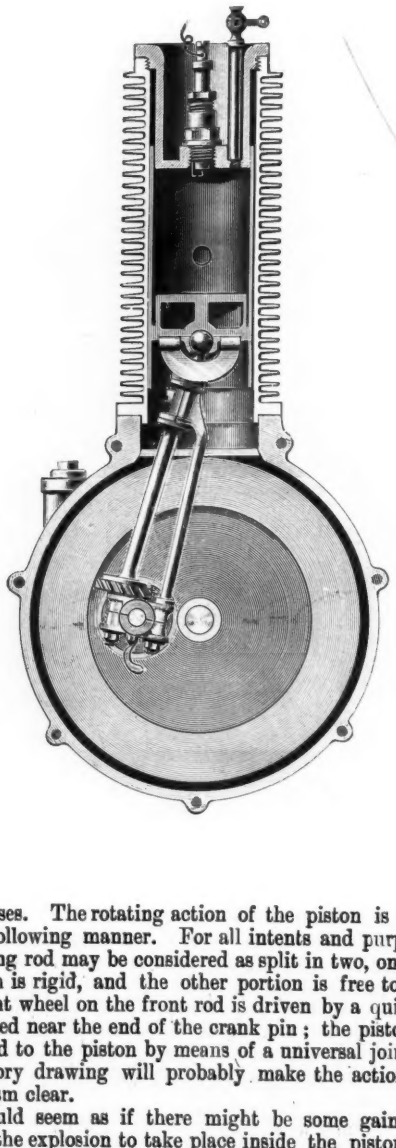
A Gas Engine Station.

In the use of gas engines for central electricity works, much interest has been recently created by the success that has attended the running of such motors at Leyton, and no doubt we may see an immediate extension of gas engine stations.

It may be a matter of interest to many of our readers to learn that for some two years there has existed at Clapham Road a central station which has attained a distinct measure of success in lighting portions of the surrounding district. The plant comprises gas engines direct-coupled to dynamos, and they vary in size from 17 B.H.P. engines down to 2½ B.H.P. The combined plant is capable of giving 1,000 amperes at 110 volts, the average nightly load being 600 amperes. The works, which are quite of moderate size, were originally started in a small dwelling house, and it may be mentioned here that the lighting plant really forms part of a business that was started by Messrs. Paris Singer & Co., to manufacture the Dawson gas engine. The lighting of a few surrounding shops and houses was attended with so much success, that extensions speedily became necessary, and to meet the ever increasing demand, a small central station was eventually erected. A view is given of the plant erected in this building, though engines of similar capacity are still working in other parts of the works. The most notable feature is that the dynamos are direct-coupled to the engines, and to give an instance as to the smallness of the floor space occupied, three sets of 11 units each only take up a space of 18 feet by 8 feet, and this leaves ample room between the machines. The sets at present in use comprise one 35-B.H.P. double cylinder engine, six sets of 11 units, three of 4 units, and two of 2½ units capacity. There are two batteries of accumulators of the E.P.S. K 66 type, which are run in parallel with the machines at the time of heavy load, and thus become effective in the event of an ignition tube breaking. The battery also takes charge of the night load, and meets the whole of the Sunday demand, the engines being shut down from Saturday night till Monday morning. Water for circulating in the cylinder jackets is pumped from a well adjoining the works to tanks placed above the engine room; after passing round the cylinders the water passes to other tanks, and from thence runs back to the well. Town gas is at present employed for the engines, but we understand that when the load increases, producer gas will be made on the premises, plant for this purpose having been already erected by Messrs. Paisley.

Undoubtedly the most interesting feature of the plant is the type of engine, which is extremely simple. It is designated the rotary piston type, and is practically valveless. The cycle adopted is the Otto, and some idea of the interior mechanism may be obtained from the detailed drawing

annexed. It should be explained, however, that this illustration is of the smaller class of engine made by Messrs. Paris Singer & Co., and is designed for motor cars. The action of the engine is practically as follows:—In every two complete revolutions of the engine, the piston is rotated completely round. As the piston is hollow, the work done by the explosive mixture is performed inside the piston. To provide for the admission of the gas, there are two holes in the piston opposite each other, and in the process of rotation, these holes become uncovered at the ports, and thus admit the mixture. During the period occupied by compressing and firing, the piston has been rotated, and at another position of the cylinder the holes become uncovered at the exhaust outlets, and the products of combustion pass out. The two holes in the piston, therefore, serve as a means of taking in the explosive mixture, and of getting rid of the



burnt gases. The rotating action of the piston is obtained in the following manner. For all intents and purposes the connecting rod may be considered as split in two, one portion of which is rigid, and the other portion is free to revolve. A tangent wheel on the front rod is driven by a quick pitch wheel fixed near the end of the crank pin; the piston rod is connected to the piston by means of a universal joint. The explanatory drawing will probably make the action of the mechanism clear.

It would seem as if there might be some gain in permitting the explosion to take place inside the piston, rather than in the cylinder; the cylinder walls are not thereby directly affected by the heated gases, neither is the lubrication of the piston interfered with.

The ordinary ignition tube is employed, the position being altered in the different sizes. A form of inertia governor is used, the regulation of the engine being effected by the hit-and-miss principle.

Probably we shall be able to say something eventually on the cost of producing electric energy at these small works. Our thanks are due to Mr. R. M. Campbell, the works manager to Messrs. Paris Singer & Co., for showing us round the works and explaining the very interesting features of the gas engine, which are now being made in considerable numbers.

ELECTRIC CRANES.

This somewhat well-worn subject has been brought before the Northern Society of Electrical Engineers, Manchester, by Mr. J. G. Statter.

The chief point of interest centres in the description of an electric crane made by the author's firm, which, for some special purposes, seems to have considerable advantages. It is a three-motor crane, in which the motors are connected in series order, and worked by constant current with variable pressure.

The motor brushes are made to rock through nearly half a circle by means of a chain and wheel, and the motors are started, stopped and reversed, simply by moving their brushes. When the brushes are on a diameter at right angles to the pole gaps there is no torque, no counter E.M.F., and no motion; but, moving the brushes to one side or the other causes a torque one way or the other and motion accordingly, so that the commutator and brushes act as their own switches, for stopping, starting, and reversing.

Such a system requires a constant current dynamo, specially designed for the crane, or a motor generator for constant current. The pressure rises and falls in accordance with the load on the motors.

The paper also describes a fanciful method of working a crane by a motor, in which the armature and field magnets both revolve; but as it is admittedly only a toy and of low efficiency, not being completely under control, it is of no interest to describe it here.

The rest of the paper deals with well-known apparatus, three-motor and single-motor cranes, without adding much to the knowledge of these already well-known and common types.

So far as we can gather, the single-motor crane finds most favour with crane makers, as it is the only system which can be readily adapted to existing cranes and to standard designs of mechanically-driven cranes. In fact, many square shaft-driven cranes have been converted, at small cost, and with little alteration, into electric cranes with a single motor. The three-motor system requires a specially constructed crane, and the series system of working with constant current requires not only a specially-made crane, but also a special generator. These, in practice, are serious drawbacks to the two latter systems.

A single motor with an open and crossed belt drive finds much favour with some crane makers, simply on account of its simplicity and effectiveness, and the same simple method is finding considerable favour in applying electro-motors to lifts, as manipulating the lift by belts has been found to be more economical and reliable than working them by purely electrical control, through a most complicated box of cam shafts, bevel wheels, clutches, and switches, all of which require continued attention. Any good motor can be used for crane driving, the details, switches, resistances, and gearing of the motor to its work are the only points in which electrical engineering problems arise.

Royal Institution.—On Friday, the 11th inst., a lecture was delivered at the Royal Institution by Dr. J. H. Gladstone, on the "Metals used by the Great Nations of Antiquity," in which he traced the growth of the metal working arts from the earliest periods of history. In connection with the occasion, a conversazione took place at the Royal Institution the same evening, which was well attended. At this a number of interesting samples of alloys and rare metals was on view, including aluminium from the British Aluminium Company, the well-known Atlas anti-friction metal, Delta metal, and rare metals from the firm of Messrs. Johnson, Matthey & Co., including a specimen of uranium, valued at £7,000.

NOTES.

(*Continued from page* 222.)

Obituary.—Our American exchanges record the death of Mr. O. B. Shallenberger, which occurred on January 24th, at the early age of 38. In 1884 he resigned from the U. S. Naval service, and devoted, from that time forth, his whole attention to electrical science. In the same year he joined the electric light department of the Union Switch and Signal Company of Pittsburg, and in 1885 he took charge of the setting up and operation of the Gaulard & Gibbs apparatus imported from Europe by Mr. Westinghouse. At this time his practical acquaintance with alternating currents began. After Stanley's experiments at Great Barrington, Mass., and other experiments conducted at Pittsburg by Mr. Shallenberger, the alternating current system was adopted, the Westinghouse Company was organised and Mr. Shallenberger was appointed chief electrician. Mr. Shallenberger was one of the earliest to apply the theories then known about alternating currents to practical operation. A contemporary remarks that he was the first in America to succeed in coupling alternating current generators in multiple. The system used for incandescent street lamps in series, with a shunt of high self-induction around each lamp, was one of his early inventions. Probably his most beautiful conceptions are exhibited in his electric measuring instruments. Mr. Shallenberger was consulting engineer for the Westinghouse Electric and Manufacturing Company, and also organiser and president of the Colorado Electric Power Company.

We regret to hear of the death of Mr. J. B. Chapman, acting principal technical officer of the Engineer-in-Chief's Office, General Post Office. Mr. Chapman, who was an old and valued servant of the department, was well known in connection with high-speed automatic working, many improvements which have been made in this system having been largely due to his initiation.

Lectures.—On the 7th inst., Dr. O. Lodge lectured at Leicester, under the auspices of the Literary and Philosophical Society, on "Electric Oscillations." Dr. Lodge said that much remained to be done before the "wireless telegraph" system could be made of practical utility. It was possible to telegraph through obstacles, but these offered more or less resistance. A message had been sent a distance of 9 miles in Germany and 15 miles in England by means of this system, and at present it was unknown up to what distance it was of use.

Mr. T. B. Murray, Glasgow, on Monday last week, lectured to the members of the East of Scotland Engineering Association on "Electric Motor Carriages." The lecturer, in his opening remarks, stated that to Edinburgh belonged the distinction of having produced the first electric carriage, which was built by a Mr. Davidson about the year 1842. Mr. Murray explained the advantages of the Johnston-Murray patent motor for this class of work. At the conclusion of his paper the lecturer showed a series of lime-light views, depicting a few historical vehicles and the latest types of American, French, and English electrical road carriages.

On the 7th inst., at the Royal College of Science, Dublin, Mr. W. Brown, B.Sc., commenced a series of 15 lectures on "The Practical Application of Electricity."

Prof. Wertheimer lectured at the Merchant Venturers' Technical College on "Wireless Telegraphy" on 5th inst., and will repeat the lecture and experiments on March 2nd.

At a meeting of the Manchester Geological Society on 8th inst., Mr. Bigg-Wither read a paper on "Electrical Shot-firing in Mines."

Prof. John Milne, F.R.S., delivered a lecture at the London Institution, Finsbury Circus, a few days ago, on "Geological Changes Beneath the Ocean."

Prof. S. P. Thompson, president of the Wolverhampton Literary and Scientific Society, will deliver his presidential address at the Agricultural Hall, on February 24th, his subject being "The Coming of the Electric Horse." He will be afterwards entertained at a supper at the Star and Garter Hotel, to which the mayor and the local members of Parliament have been invited.

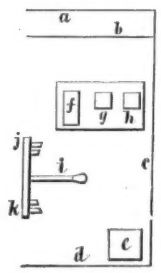
The Telephone and the Electric Tramway Wires in South Staffordshire.—On Wednesday, at the Walsall County Court, before his Honour Judge Griffith, the National Telephone Company, Oxford Street, London, were sued by Messrs. Bedworth & Son, merchants, of 10, Mill Street, Great Bridge, for £37 4s., the price of a horse, the death of which was caused by one of the company's telephone wires giving it a fatal shock. Mr. Ensor appeared for the company, and claimed that the South Staffordshire Tramway Company should be joined with them as defendants, as they were jointly liable. Mr. Disturnal appeared for the tramway company, and Mr. Parfitt represented the plaintiffs. The case was not gone into, but the facts were stated to be that a man in the employ of the telephone company was engaged in repairing one of the wires, and that while so engaged the wire fell across another wire, the latter belonging to the tramway company. This sent through it a current which made the man drop the wire, and after it had fallen plaintiffs' horse became entangled in it, and was fatally shocked. Mr. Ensor urged that the tramway company were bound to insulate their wires, and as they had failed to do this, they were really responsible for the accident. Mr. Disturnal submitted that to make a third party liable in such a case, liability to indemnify must be shown. His Honour held that the falling of the telephone wire on the tramway wire was a trespass, and that the tramway company could not be held liable for that. He therefore dismissed the action against that company with costs. Mr. Parfitt said that, after Mr. Ensor's argument, there could be no defence against plaintiffs' claim, as the parties had agreed that the damages were £35 4s. 6d. He asked his Honour for judgment for that sum. Mr. Ensor said his only defence was, that it was the electricity passing from the tramway wire to the telephone wire which had caused the man to drop it, and it was in that wire that the horse was entangled. He submitted to his Honour that if he were holding a cannon ball, and someone struck his arm and caused him to drop the ball on another person's toes, the man who struck the blow would be liable. This was a similar case. His Honour declined to give judgment on hypothetical cases, but said the telephone company had no right to let their wire rest on the tramway company's wire. Mr. Ensor said that, under the circumstances, he must submit to judgment, which was therefore given for £35 4s. 6d. and costs.

Presentations to Mr. H. C. Fischer.—Mr. H. C. Fischer, C.M.G., who retires from the Post Office service at the end of the month, took formal leave of the officials on Thursday last week, at St. Martin's-le-Grand. Among the presentations from the various departments were the following:—Silver candelabra from Mr. Fischer's personal staff and the controlling and supervising officers (male and female), past and present, of the Central Telegraph Office; three silver fruit dishes, with inscription and monograms, from personal friends in other branches of the Post Office; a brown leather Gladstone dressing bag, containing silver-stoppered cut-glass bottles and silver-mounted fittings; a silver cigar box (cedar wood lined) bearing an engraved centre piece representing a cable with ends showing, presented by the officers of the late Submarine Telegraph Company who were transferred to the service of the Post Office in 1889; a smoker's cabinet, of polished coromandel wood, with silver fittings, from members of the male staff of the Central Telegraph Office; and a silver vesta box, bearing initials H. C. F. and date, from Mr. Fischer's head messenger and his assistant. Mrs. Fischer was presented with a handsome diamond ruby and pearl bracelet.

The Institution of Civil Engineers.—On Tuesday next papers will be read on "The Theory, Design, and Practical Working of Alternate-Current Motors," by Llewelyn B. Atkinson, Assoc.M.Inst.C.E., and "Dublin Electric Tramways," by H. F. Parshall, M.Inst.C.E.

The Ferraris Memorial.—The German fund in aid of the proposed memorial to the late Galileo Ferraris amounts to £190. Of this sum, Dr. Kittler has collected £68, whilst the remainder comprises contributions obtained through the efforts of the editors of the *Elektrotechnische Zeitschrift*.

Ingenious "Booster" Connections.—Mr. James F. Austin, of Philadelphia, writing to the *Street Railway Journal*, says:—"Making the most of things," is the street railway man's watchword now-a-days, and the man who really can make the most of things generally comes out pretty near the top. In a power house not long since, I found a very ingenious arrangement of the generators, whereby one, or three, might be used as the very fluctuating travel demands. In the drawing, the line is shown, the several divisions being designated as follows: *a* and *b*, branches; *c*, main line, and *d* an extension of the main line three miles long and beginning about five miles from the main power station in which were three units; *f*, a modern direct connected generator running at 90 revolutions per minute, and having an output of 1,300 or 1,400 amperes. The smaller generators, *g* and *h*, were of the type of five or six years ago. At *e*, another station was located which could start one of the older generators at will. This company operates about 160 cars, and has a seaside resort at the end,



d, and travel varies from a full load for all the units, to a small load for generator, *g*. In the main power station, connections are such that the three generators can all be operated in multiple, or as travel demands, the line, *b*, can be put on unit, *g*, and the main line and branch, *a*, operate from *f* and *e*. By another combination, the generator, *h*, can be connected up as a "booster," and the main line, clear to and including *d*, may be operated from unit, *f*, and the booster, *h*, without the use of the generator at *e*. The connection of the generator, *h*, is through the switch, *i* (shown in detail), and when the lever, *i*, is thrown in contact with *j*, the generator is running in multiple with the others, but when the lever is thrown to *k*, the connections are such that the machine becomes a "booster," and works in that capacity with whatever feeders may be connected with it. The switch connections are such that either of the branches can be "boosted" or isolated to a single generator at will.

Petroleum Fuel.—The *Scientific American* remarks that it is gratifying to learn that the experiments which the Bureau of Steam Engineering is carrying out in the Stiletto in the use of liquid fuel are meeting with complete success. The great advantages of liquid fuel are, that it may be run into the bunkers or tanks by gravity, thus doing away with the tedious and costly loading by hand. It can be brought into the furnaces without handling, thus reducing the number of stokers, and it produces no ashes. A ton of oil, moreover, contains about twice as much heating power as a ton of coal, and hence the amount of fuel supply may be doubled without adding to the weight of the vessel. With a combination of liquid fuel and the turbine in the same vessel, we may look for some great developments in the present Government experiments.

Informations!—The following note from a correspondent speaks for itself:—"Kindly favour me in asking some one of our numerous readers to give us a few practical hints on the drum bar wound armatures, evolute end windings, the best means in conecting up the joints. You will extreemly oblige C. W."

Heat and Mechanical Work.—The highly interesting article by Marcel Deprez, which appears on page 239, was communicated by the author to the *Revue Générale des Sciences*.

Behr's Lightning Express.—Mr. F. B. Behr informs the *Times* that the Belgian Government has named a commission composed of the following engineers in the service of the State railways:—M. E. Gerard, engineer-in-chief and Chef du Cabinet of the Minister of Railways (president), M. A. Degraux and M. Flamasche, engineers-in-chief of the State railways, and M. Robert, engineer of the State railways (secretary), for the purpose of carrying out a series of important experiments on Mr. Behr's lightning express railway, constructed for that purpose in the neighbourhood of Brussels. Mr. Behr says that in the event of the report of the commission being in every way satisfactory, the Government would agree to the building of an important line on his system. A syndicate has been formed in Brussels, consisting principally of some of the leading bankers in that town, who are providing the money for the purpose. The experiments will begin towards the end of this month, and are expected to last about three months.

Cost of Steam in 1870 and 1897.—One the best papers recently read before the American Society of Mechanical Engineers (says the *Scientific American*), was presented by Mr. F. W. Dean, on the decrease in the cost of steam power between the years 1870 and 1897. This was shown to amount to nearly 40 per cent.; 17 per cent. of this is attributed to the use of multiple cylinder engines, steam jacketing, higher steam pressure and superheating the steam. Five per cent. is due to the use of vertical engines, 7 per cent. to improved boilers, 7 per cent. to economy realised in heating the feed water, and 2 per cent. is put down to the credit of improved construction of grates. Taking the best performances of the two periods named, the least consumption of steam per horse-power per hour in 1870 was 20 lbs., whereas the best for 1897 was $12\frac{1}{2}$ lbs.

Electric Radiation.—Prof. Chunder Bose has communicated two papers to the Royal Society on experiments with electric radiation. It will be within the memory of his recent audience at the Royal Institution that a particular feature of his work in this subject is the reduction of the size of the apparatus employed to that of ordinary optical instruments. He has effected this by using oscillations of wave lengths much shorter than were employed by Hertz or Fitzgerald, though, of course, enormously longer than those of visible light. The experiments described refer to the refraction, and total internal reflection, by glass of electric radiation. The experiments on refraction were designed to test the application to glass of Maxwell's relation between the specific inductive capacity and the refractive index. It was found to be 2·04 for the wave length employed (that for visible light being about 1·5), which would make the inductive capacity 4·16. Different observers are said to have assigned to the inductive capacity of glass of various kinds values lying between 2·7 and 9·8. Hopkinson's figures, given by Prof. Everett, range only from 6·57 to 10·1. The second set of experiments was mainly directed to ascertaining the minimum air distance between two parallel surfaces of glass which would produce total reflection, and appear to have given very precise and satisfactory results. In both sets the oscillator used was the form in which a small central sphere is placed between two small spherical beads, the receiver being a Branly tube. The principal difficulty with the apparatus was so to shield the receiver that it should be affected only by radiation from one particular direction, and we may refer our readers to Prof. Bose's papers for the details of the way in which this was met.

The Brighton Engineer.—The condition attached to Mr. Arthur Wright's appointment as manager of the Brighton Corporation Electricity Works, requiring him to give his whole time to the duties of that office, has been waived, and Mr. Wright will be permitted to take private practice as an advising electrical engineer to other companies or corporations outside the borough.

Accumulator Traction on Common Roads.—Before the Self-Propelled Traffic Association on March 29th, Mr. J. T. Niblett will read a paper on "Recent Improvements in Accumulators, and in their Application to Traction on Common Roads."

Comparison Between Horse-Keep and Motor-Keep.—The *Automotor and Horseless Carriage Vehicle* extracts the following interesting comparison made by M. D. Creuzan, President de l'Automobile Bordelais, in *La France Automobile*:—

Daily Keep of Two Horses.

	Francs.
Food, hay, &c.	5.0
Litter	1.0
Smith	0.30
Harness	0.50
Rent of stable	0.50
Veterinary, &c.; repairs to carriage, stable and harness	1.15
Total	8 45

Daily Cost of an Automotor Vehicle.

Daily journey, 30 miles.

	Francs.
6 litres petrol	2.10
Oil, waste, &c.	0.15
Repairs	1.00
Use of rubber tyres, &c.	1.25
Total	4.50

Daily saving by using an automotor, 3.55 francs.

The editor of the *Automotor* advises his readers to turn back to its issue for October, and read up the article on "Kelvin's Law of Economy," and apply the above figures or others to any given case, a most instructive and accurate conclusion will be reached, viz, that *it is always much cheaper to use an automotor vehicle.*

North-Western Electrical Association.—The sixth annual convention of this Association was held in Milwaukee on January 19th, 20th and 21st. Mr. H. C. Higgins delivered the presidential address. The following were among the papers read:—"Practice of Theory," by J. C. McMynn; "Electric Lighting for Profit," by Alex. Dow; "Topics of Interest to Central Station Men," by Lieut. F. A. Badt; "Long Distance Transmission," by A. Ekstrom; "Present Efficiency of Incandescent Lamps," by J. E. Randall; "Physical and Chemical Properties of Volatile Oils in Boilers," by W. H. Edgar; "Electricity in Municipal Engineering," by Prof. R. B. Owens; "Municipal Socialism," by F. De Land; "Depreciation," by Prof. Jackson. There was a long discussion on municipal lighting plants.

Treatment of Consumption by Electricity.—According to *Electricity*, New York, a well-known physician, Dr. J. Mount Bleyer, is said to have discovered a method of curing consumption by the use of the electric current. Dr. Bleyer's system is based on the well-known principle that electricity can be made to act as a purifying agent by virtue of the ozone which, under certain conditions, it gives forth. Dr. Bleyer revivifies the blood of the patient by giving ozone. He places pads on the patient's chest, directly over the diseased part of the lung, and a pad on the corresponding point at the back. A current of electricity at extremely high voltage is sent directly through the body for 20 minutes or half an hour. Dr. Bleyer does not specify the amount of electricity he uses, fearing that inexperienced professionals may make the experiment with perhaps fatal results; neither does he say whether he uses direct or alternating currents. It has been proven, it is said, by experiments on rabbits, that the electric current really revivifies the blood by giving it ozone. Advanced stages of consumption cannot be cured by the Bleyer system, but it is claimed that such patients as possess enough of the lung substance as will carry on the physiological processes are susceptible of an absolute cure within a reasonable space of time, by the daily application of the current.

The Royal Society.—Before this society yesterday afternoon the following papers were down for reading:—Prof. A. Gray, F.R.S., and Prof. J. J. Dobbie, "On the Connection Between the Electrical Properties and the Chemical Composition of Different Kinds of Glass;" Dr. E. Taylor, "On the Magnetic Deformation of Nickel."

Multiphase Work.—We learn from a Glasgow daily that a handsome new beam and girder shop has been erected at Glengarnock. It is being driven electrically by Mr. Walter Dixon, of Glasgow, on the multiphase system.

Kruger, the Father of Arts and Inventions.—The Government fees in the Transvaal have not, up to the present, been very high; they have now been increased by the Law, and inventors will have to pay:—

	£	s.	d.
At the deposit of the application	1	1	0
At the deposit of an objection	2	2	0
At issuing a certificate by the Commission	1	1	0
For sealing and signing the Letters Patent	5	0	0
Before the expiration of the term of 3 years ...	20	0	0
" " " 5 to 8 years ...	100	0	0
" " " 8 to 11 years	150	0	0
" " " 14 years ...	200	0	0

The preamble of this new fiscal law is exquisite. Whereas it is desirable to encourage the working of new and lawful inventions, by granting to the inventor, for a fixed period, the exclusive right to exploit his own invention for his own benefit. . . . . President Kruger has a peculiar way of encouraging the inventors!

Electric Light Mains.—From the *Birmingham Daily Gazette* we learn that, "the defects in the supply of electric light at Burton-on-Trent were the subject of an important statement by Alderman Lowe. He said the committee had communicated with about 30 other cities and towns where electric light was used, and had ascertained that in almost every case where the Silvertown cables were used there had been more or less serious defects and breakdowns. Through the kind intervention of Lord Burton, a deputation of the Council had been to London and had a conference with Mr. Frank Bailey, engineer to the City of London Electric Lighting Company, and that gentleman had given them some very valuable information, and they hoped to be able to get Mr. Bailey to visit Burton, and to advise them on the best remedy. He had advised the substitution of the British Insulated Wire Company's cables, and this, Mr. Lowe estimated would cost from £5,000 to £6,000." It is not a little curious that the article in our leading pages this week should have a direct bearing upon the subject of mains, and the above note gives very striking evidence that we have struck the keynote of a matter of vital importance to electricity supply companies. We are aware that the manager and engineer of the Gas and Electric Light Works, Burton-on-Trent, issued a circular letter to various engineers throughout the country, in which he complained of the trouble he was experiencing with high tension mains of Silvertown make, and asking for answers to a set of questions which would be treated *as confidential.* Perhaps Mr. Ramsden will be good enough to communicate to us the replies he received to his circular, as we are desirous of investigating this matter; or if the engineers with whom Mr. Ramsden communicated will send us copies of their replies, we shall be glad to receive them, *absolutely* in confidence. It would be interesting also to learn whether Mr. Frank Bailey had advised the substitution of another kind of cable for those of Silvertown, on the strength of a personal examination and test! Finally, we wish to ascertain whether the mains complained of in 30 cities and towns were jointed and laid by the Silvertown employés, how many years they have been laid, and whether before or after the Board of Trade regulations? We hold no brief, it is scarcely necessary to say, for any cable or other firm; but we cannot forbear entering a protest against a line of policy which seems to have been organised for the express purpose of producing a "scare" in rubber cables.

Reis Memorial.—The Physikalische Verein of Frankfort-on-the-Maine propose to erect a memorial to the late Philipp Reis, the inventor of the telephone. The society, of which Dr. Petersen is the president, have appointed a committee to further the scheme, the carrying out of which is estimated to cost about £1,500.

Forthcoming Book.—Messrs. Crosby, Lockwood & Son announce that the work on "Submarine Telegraphs: their History, Construction, and Working," by Mr. Charles Bright, F.R.S.E., will be published very shortly. The subscription price ceases to apply on the date of publication. Subscription orders should reach them not later than Monday, February 28th.

The Shannon Water-Power Scheme.—The *Times* for Monday contains some particulars of this scheme. A meeting of riparian promoters and others interested in the fisheries of the Shannon was held on Saturday to consider the scheme, from which the promoters anticipate important results in the public electric lighting of various centres in Ireland. The scheme, in which Lord Lurgan, Sir Gerald Dease, and other gentlemen are concerned, is for the erection of electric works and machinery at Landscape, on the Clare side of the Shannon, below Castleconnel, the intake for the supply of water for the turbines being between Castleconnel and O'Brien's Bridge. The canal, a cutting of some two miles in length, will convey 55,000 to 60,000 cubic feet of water per minute for the turbines during the 10 hours of each day that they are to be worked. To meet any deficiency of the volume of water in the summer months, and during seasons of drought, the syndicate proposes to store water at Lough Allen, which has an area of 9,000 acres, the 60,000 cubic feet of water required to work the machinery being by this means available, without possible detriment to other interests, when it could not be had through the ordinary flow from the river. Other safeguards are also mentioned, and the syndicate states that it is prepared to compensate any injury proved to be done to the fisheries by the contemplated works. Lord Massy presided at the meeting, and there was a large attendance, including Lord Lurgan, Sir Gerald Dease, Mr. H. C. Fuller, engineer of the proposed scheme, Mr. V. W. Brown, and Mr. Fitzgerald, C.E. Mr. Fuller explained the details of the scheme, which was subjected to criticism from several gentlemen present. Lord Lurgan asked those present to look on that as a preliminary meeting, and to arrange for conferring with him and his colleagues after a reasonable time had elapsed, and when the details were more advanced. The enterprise was a very large one, he might say a national enterprise, and it should not be lightly cast aside. A further meeting will be held at an early date.

Stone-Throwing at Telegraph Wires.—The Education Department, Whitehall, has been circularising the correspondents of schools on the great damage done to telegraph wires and insulators through mischievous stone-throwing. The following circular, which was issued in 1875 and 1885, is again being sent out:—"The Duke of Richmond is informed that so much damage is done to postal telegraph lines by stone-throwing, that her Majesty's Postmaster-General is compelled to put the law in force against offenders. Most of the damage is caused by mischievous persons; but it is found that much injury is done by school boys, who do not think they are doing any great harm, and are not aware that they render themselves liable to imprisonment, and perhaps to flogging. You are hereby requested to be good enough to caution the children in your school against throwing stones at the telegraph lines, and to impress upon them the risks they run, and the great expense, trouble and annoyance they cause by so doing."

Early Electric Tramway Practice in the States.—We quote the following editorial from the *Street Railway Journal*:—"In the discussion of Philip Dawson's paper on 'Electric Traction' before the (London) Institution of Electrical Engineers, one of the speakers is reported to have denounced with vigour and point 'American haphazard methods. Their standards are no standards at all; they go full speed ahead, and then have to go astern.' There is possibly some basis for this criticism. Nearly the entire burden of experimentation in electric traction has fallen upon America, and it is inevitable that there should have been much duplication of plant in the progress of an industry from birth to what we might call now, perhaps, middle age. Nevertheless, there is one element in the case which is too frequently overlooked by the more conservative engineers and tramway managers both here and abroad, and that is, that the pioneers in the industry who have gone ahead courageously and put in the best apparatus known at the time, have frequently made enough money by doing so to purchase more improved apparatus as it has come out. This is true not only where there has been competition, and where the lines equipped with the better motive power have gained traffic at the expense of their more conservative competitors, but also in cities where there has been no competition, for the development of the 'riding habit' in American municipalities through the introduction of electric traction has been one of the marvels of the American financial world. Sooner or later this feature will, of course, be understood more generally abroad, but meanwhile 'conservatism' will, no doubt, plume itself upon its wisdom, while somewhat forgetful of certain advantages of 'progressiveness.'"

Portable Tools.—We have pointed out that electricity is working in the direction of portable tools where the work is large. *Machinery* illustrates a very convenient portable boring and drilling machine by the Newton Tool Works of Philadelphia. This machine has a base with slide, carrying a stout post. The post carries a horizontal spindle. There are two motors in the machine; one drives the machine and the feed, the other serves simply to raise and lower the head upon the post. The boring bar is driven by a steel worm and phosphor bronze wheel, triple threaded. A lifting shackle is provided for the crane hook to take. The machine is specially adapted for the drilling of the large yokes of motors and dynamos, but is, of course, applicable to any other work. It is a good sample of the new departure in tool making, which electricity has brought about, and which would have hardly been practicable—scarcely, indeed, possible without the new agent of transmission.

NEW COMPANIES REGISTERED.

Rochdale Electric Company, Limited (55,887).—Registered January 31st, with capital £5,000 in £1 shares, to adopt an agreement with W. D. Watson, and to carry on the business of electricians, suppliers of electricity, electrical engineers, electrical apparatus manufacturers, &c. The subscribers (with one share each) are:—W. D. Watson, Falinge Road, Rochdale, silk manufacturer; R. T. Golding, 25, Cambridge Road, Seaforth, Liverpool, chartered accountant; T. Snape, J.P., The Gables, Croxteth Road, Liverpool; T. Watson, Carr Hill, Rochdale, silk manufacturer; Miss M. G. Lendrun, 5, Croxteth Road, Liverpool; Mrs. M. M. Watson, Lydstep, Falinge Road, Rochdale; R. Watson, Oak Cottage, Shawclough, silk manufacturer. The number of directors is not to be less than two nor more than four. The first are T. Snape and W. D. Watson. Qualification, £100; remuneration as fixed by the company. Registered by C. Doubble, 14, Serjeant's Inn, E.C.

Warrington and District Electric Light and Power Company, Limited (55,890).—Registered January 31st with capital £2,000, in £1 shares, to adopt a certain agreement and to carry on the business of electrical and mechanical engineers and contractors, electricians, suppliers of electricity, iron and brass founders, &c. The subscribers (with one share each) are:—R. W. Francomb, Wilderspool, near Warrington, merchant; W. H. Robinson, 49, Wilson Patten Street, Warrington, secretary; J. Cannell, Academy Street, Warrington, physician; A. Curran, Grappenhall, Chester, civil engineer; A. Polley, Wilderspool Road, near Warrington, gentleman; H. W. Francomb, Wilderspool Road, near Warrington, student; C. L. Clarke, 7, South Parade, Manchester, electrical engineer. Table "A" mainly applies. Registered office, 117, Sankey Street, Warrington.

Electrical Works Company, Limited (55,892).—Registered February 1st with capital £10,000 in £1 shares, to carry on the business of electricians, mechanical engineers, suppliers of electricity, and manufacturers of electrical apparatus. The subscribers (with one share each) are:—W. M. M. Forwood, 15, Union Court, Liverpool, solicitor; C. O. Grindrod, 11, Knowsley Road, Rock Ferry, Chester, gentleman; A. E. Haptie, 5, Durham Road, Seaforth, Liverpool, clerk; F. W. Lintern, 104, Northbrook Street, Liverpool, clerk; A. Ruckley, 8, York Road, Seacombe, Chester, clerk; R. Smith, jun., 14, Bramham Gardens, South Kensington, gentleman; J. T. Downes, 8, Marlborough Villas, Wimbledon, clerk. The number of directors is not to be less than two nor more than seven; the subscribers are to appoint the first. Registered by F. J. Leslie & Co., 15, Union Court, Liverpool.

Perth Electric Lighting Company, Limited (55,898).—Registered February 1st, with capital £1,000 in £1 shares, to carry on at Perth, W.A., or elsewhere, the business of electricians, mechanical engineers, suppliers of electricity, and electrical apparatus manufacturers. The subscribers (with one share each) are:—E. Pope, St. Stephen's Chambers, Telegraph Street, E.C., gentleman; J. Doyle, 22, Brompton Square, S.W., gentlemen; J. D. Mackenzie, 12, Redcliffe Square, S.W., gentleman; G. T. Bean, 257, Winchester House, E.C., chairman of company; H. J. Dixon, 257, Winchester House, E.C., secretary; J. J. Daynes, 22, Graham Road, Lower Edmonton, gentleman; F. R. Wolseley, Elmwood, Catford, S.E., gentleman. Table "A" mainly applies. Registered by Williams and Neville, Winchester House, E.C.

Perth Tramways, Limited (55,935).—Registered February 4th with capital £125,000, in £1 shares, to acquire, own and work any concessions, rights and privileges connected with the construction and laying down of tramways in Perth, W.A., or elsewhere, and to equip, maintain and work by electricity, steam, horse, or other mechanical power such tramways. The subscribers (with one share each) are:—E. Pope, St. Stephen's Chambers, Telegraph Street, E.C., gentleman; J. Doyle, 22, Brompton Square, S.W, gentleman; J. D. Mackenzie, Bart., 15, Redcliffe Square, S.W., gentleman; G. T. Bean, 257, Winchester House, E.C., chairman of company; H. J. Dixon, 257, Winchester House, E.C., secretary; J. J. Baynes, 22, Graham Road, Edmonton, N., gentleman; F. R. Wolseley, Elmwood, Catford, S.E, gentleman. Registered without articles of association. Registered by Williams & Neville, Winchester House, E.C.

Buenos Ayres and Belgrano Electrical Tramways Company, Limited (55,957).—Registered February 5th with capital £850,000 in £5 shares (40,000 "A" preference, 30,000 "B" preference, and 100,000 ordinary), to adopt agreements with the Buenos Ayres and Belgrano Tramways Company, Limited, and to acquire, own, and work any tramways, light railways, cars, omnibuses, engines, electrical plant, &c., in the Argentine Republic, or elsewhere. The subscribers (with one "B" preference share each) are:—H. Dixon, jun., 6, Vale Road, Finsbury Park, N., gentleman; G. Proctor, 100, Harberton Road, Whitehall Park, N., gentleman; P. H. Lyne, 7, Ledbury Road, South Croydon, gentleman; A. S. Farmer, Holmside, Arkley, Herts., gentleman, B. J. Tunbridge, Eden House, South Woodford, gentleman; B. G. Gouk, 3, Inderwick Road, Hornsey, N., gentleman; E. Temple, 30, Byron Avenue, East Ham., E, gentleman. The number of directors is not to be less than four nor more than seven; the subscribers are to appoint the first; qualification, £500; remuneration £1,500 per annum, and 10 per cent. of the net profits, after paying 5 per cent. per annum on all shares dividend. Registered by Ashurst & Co., 17, Throgmorton Avenue, E.C.

La Capital (Extensions) Tramways Company, Limited (55,966).—Registered February 7th with capital £100,000 in £1 shares, to acquire, work, and turn to account a concession for the construction and working of tramway lines from a point on the system of La Capital Tramways, Limited, to Mataderos, in the Argentine Republic, and to carry on the business of an electric light and supply company. The subscribers (with one share each) are:—S. H. Granger, 271, New North Road, N., clerk; F. Thursby, 10, Draper's Gardens, E.C., solicitor; C. Hamwerck, 125, Goldhurst Terrace, N.W., gentleman; T. Hinds, 12, The Avenue, Blackheath, secretary; G. H. Short, 13, Cross Street, Hatton Garden, E.C., manager; J. C. Pease, 58, Jermyn Street, S.W., advertising expert; J. N. Bartlett, 2, George Villas, Prince's Road, Romford, clerk. The number of directors is not to be less than three nor more than seven. The subscribers are to provide the first. No qualification; remuneration as the company may decide. Registered by Budd & Co., 24, Austin Friars, E.C.

Self-Charging Electrical Traction Company, Limited (56,043).—Registered February 10th with capital £100 in £1 shares, to acquire, own and work, any patents and rights relating to the production, treatment, storage, application, distribution and use of electricity, and particularly in relation to the use of electricity for the purposes of the propulsion of vehicles. The subscribers (with one share each) are:—F. S. Gaylor, 74, Stockwell Park Road, Clapham, clerk; T. G. Norris, 6, Prideaux Road, Clapham, stationer; P. L. D. Perry, 40, Holborn Viaduct, secretary; R. W. Smith, 40, Holborn Viaduct, gentleman; J. Likeman, 47, Holborn Viaduct, registrar; W. O. Wheeler, 252, Cornwall Road, Bayswater, clerk; A. Burgess, 48, Constance Road, East Dulwich, gentleman. Registered, without articles of association, by Steadman and Van Praagh, 40, Holborn Viaduct, E.C.

Dennelle & Co., Limited (56,049).—Registered February 10th, with capital £10,000 in £1 shares, to carry on the business of French art metal workers, brass or metal founders, metal chasers, silk shade makers, manufacturers of wires, cables, and lines, electricians, suppliers of electricity, engineers, &c. The subscribers (with one share each) are:—R. T. Smith, Linford, Essex, gentleman; C. M. Escare, 23, Whitfield Street, W., art metal worker; J. J. Rawlings, Roselea, Galveston Road, Putney, engineer; E. J. Nicholson, 185A, Earl's Court Road, S.W., engineer; C. H. Fleetwood, 196, High Street, Harlesden, secretary: W. R. Rawlings, 6, Gartmoor Gardens, Wimbledon, S.W., electrician; W. Helliwell, 230, Amhurst Road, N.E., gentleman. The number of directors is not to be less than three, nor more than five; the first are E. M. Escaré, and R. T. Smith. Qualification, 50 shares. Registered by Turner & Co., 61, Carey Street, W.C.

Berrenberg Electric Lamp Syndicate, Limited (56,054).—Registered February 11th with capital £10,000 in £1 shares (100 founders), to acquire, own, and work any inventions for the manufacture of electric lamps and similar appliances, and to adopt an agreement with A. Berrenberg. The subscribers (with one share each) are:—G. H B. Glasier, Edgecombe Hall, Wimbledon Park, gentleman; A. Halford, 7, Pembridge Square, W., gentleman; J. Howard, Blomidon Cranes Park, Surbiton, gentleman; A. Berrenberg, 11, Crystal Palace Station Road, Upper Norwood, engineer; R. J. Preston, 111, Alexander Road, Wimbledon, solicitor; W. J. Collyer, 13, St. Stephen's Road, Bayswater, solicitor; J. S. Glasbo, Ashmere Road, St. Peter's Park, W., clerk. The number of directors is not to be less than three nor more than seven; the subscribers are to appoint the first; qualification, £100; remuneration as fixed by the company. Registered by Burton & Co., 23, Surrey Street, Strand.

Electrical Inventions and Manufacturing Company, Limited (56,073).—Registered February 12th with capital £5,000 in £1 shares, to adopt an agreement with J. Moores and H. O. Farrell, and to carry on the business of electricians, electrical and mechanical engineers, suppliers of electricity, &c. The subscribers (with one share each) are:—H. O. Farrell, 15, Hanging Ditch, Manchester, electrical engineer; C. H. Cox, 24, Fern Grove, Liverpool, clerk; J. W. Bennett, Tower Cliff, New Brighton, manager; J. W. B. Lockwood, 22, Trinity Road, Bootle, engineer; J. Moores, 15, Hanging Ditch, Manchester, electrical engineer; M. H. Barber, 10, Corporation Street, Manchester, electrical engineer; J. Woods, Burnage Lane, Didsbury, Manchester, secretary; S. E. Linsell, 33, Holland Road, Chorlton-cum-Hardy, electrical engineer. The number of directors is not to be less than two nor more than five; the first are J. Moores and H. O. Farrell. Registered by Bowden and Widdowson, 19, Brazennose Street, Manchester.

CITY NOTES.

Waterloo and City Railway Company.

The eighth half-yearly general meeting of the shareholders of the above company was held on Thursday, February 10th, at Waterloo Station, Mr. Wyndham S. Portal presiding.

The Chairman said it might interest the shareholders to know that there were now 732 holders, as compared with 669 at the meeting last August, and with 600 at the meeting in February, 1897. After referring with regret to the absence, through illness, of Mr. A. E. Guest, one of the directors, the chairman said that the report and accounts were very plain, and could be easily understood by any shareholder. The accounts as they stood gave satisfactory results, both as to the rate of expenditure in the past, and the probable outlay in the future. They had received the whole of the share capital of £540,000, out of which they had expended £360,605 down to the end of June, 1897, and a further £113,170 had been spent during the past half-year, making the total outlay to December 31st, 1897, £473,776. That total included the sum of £25,000 for interest paid to the shareholders during the construction of the line as authorised by the Act of incorporation. The principal item of expenditure last half-year—£80,037, was made up of £76,765 to the contractors for the works, and £3,272 to the engineers for their services. He regretted to say that one of their engineers, Mr. Galbraith, whose services they valued exceedingly, was very unwell, and his doctor had forbade him to attend the meeting. They had, however, Prof. Kennedy with them, who would be happy to give any information that might be required respecting the engineering work. The next large item in last half-year's payments was £24,839, which was for the electrical equipment of the railway. The interest and commission item, £3,289, represented the amount chargeable to capital under that head, after deducting the credit of £1,992 for interest received on their Parliamentary deposit and their bank account. The probable future outlay of the line was estimated at about £103,000, and that was more than covered by their remaining capital powers, which amounted to £237,890. The sum of £8,333 in the accounts was the amount which the Act compelled them to deduct from their debenture powers, representing one-third of the £25,000 which they had paid for interest out of capital, so reducing their further loan capital powers to £171,666—£7,046 for interest accrued and provided for was the amount divided among the shareholders for the past half-year. At the last meeting he referred to the question of calls, and it was gratifying to be able to state that there were no arrears in respect of their final call, everything having been paid up. The whole of the share capital having now been fully paid up, they were in a position to avail themselves of the provisions of the Companies' Clauses Consolidation Act, 1845, and convert the shares of the company into a general capital stock. The directors advised that advantage should now be taken of those powers, as tending to benefit the shareholders. The stock would be much more marketable, and in a much more convenient form. As regarded the work done in the construction of the railway, he could not do better than read the short but interesting report of the engineers. That report told them that all the tunnels were finished except a portion of the white glazed tiling in the up City Station tunnel, and in the inclined approach to the Central London Company's subways at the Mansion House. In the down or southern tunnel the permanent way had been laid from Waterloo to the cross-over road at the western end of the City Station, and in the up or northern tunnel the permanent way had been laid from Waterloo to the river shaft, and the remaining length of road laying was in hand. The low level station at Waterloo was finished, and two of the three communications between the high and low level stations were finished, and the other one would be ready by the end of the month. The yard for the terminal sidings at Waterloo was finished and ballasted, and more than half of the sidings had been laid. The whole of the permanent way materials for the sidings were on the ground. In the generating station the first portion of the engine and boiler houses is ready for the reception of the machinery. Two engines had been fixed, and all the boilers were now in position. In addition to the engines mentioned above, the remaining four machines and the whole of the dynamos were nearly ready, and the switchboard work and other apparatus for the station was far advanced. The travelling crane was delivered and in use. The electrical work in both tunnels was now complete as far as the river shaft. Beyond the shaft the contractors for the electrical work were following on towards the City as quickly as possible, and would

reach the cross-over road in the down tunnel in about a month. The rolling stock had been delivered to the London and South-Western Railway Company, and was now being erected at their Eastleigh Carriage Works. One train is complete, and was quite ready to be lowered as soon as the lifts were ready to lower it into the tunnels. The signalling arrangements had been approved by the Board of Trade. The contract for the work had been let, and fixing would shortly be commenced. The works now remaining to be completed were (1) the permanent way in the up tunnel between the shaft in the River Thames and the City station, and already 80 per cent. of the permanent way had been laid complete. (2) Portions of the platforms and tiling in the City station and inclined approach tunnel, and the short staircase and landing connecting the inclined tunnel with the up and down platforms. (3) The remainder of the buildings at the generating station at Waterloo. All the above were expected to be ready by the middle of March. The large lift for lowering the rolling stock was making good progress, and was expected to be in working order on or before February 20th. Of the two temporary exits for passengers at the Mansion House (pending the completion of the Central London subways), one was well advanced, and it was hoped would be ready simultaneously with the completion of the Waterloo and City Railway. The other was progressing, but its completion depended upon the levels of the gas and water mains at the eastern end of Queen Victoria Street, the exact positions of which has not yet been definitely ascertained by the Central London Railway Company, by whom those outlets were being constructed. It was to be regretted that the Central London Company's subways at the Mansion House would not be ready by the time their railway was finished, and to bring the line into use at the earliest possible date, temporary exits would be provided. They were disappointed that they had not been able to commence the new year with the line open, but that was no fault of the directors or the contractors, nor of the Central London Company. The underground pipes met with had created difficulties and delays which were unavoidable. Those were now disappearing, and they expected to be able to arrange with the London and South-Western Railway for bringing the line into use by the middle or the end of next month. They would, therefore, shortly be in a position to realise the earning capabilites of the railway, and they had every confidence that it would prove of great public service in providing a convenient and expeditious means of communication between Waterloo and the City, and that it would be a safe and profitable investment to those who had contributed to the undertaking.

Col. the Hon. H. W. CAMPBELL seconded the motion, and the report was adopted.

The CHAIRMAN then submitted a formal resolution providing that from March 1st the whole of the share capital of the company be converted into general capital stock and divided amongst the shareholders according to their respective interests.

Col. CAMPBELL seconded the resolution, which was carried.

The retiring directors and the auditor having been re-elected, the proceedings terminated with a vote of thanks to the chairman for presiding.

Westminster Electric Supply Corporation, Limited.

THE ordinary general meeting of the shareholders of this company was held on Wednesday last at the offices, Eccleston Place, Belgravia, Lord Suffield, K.C.B., in the chair.

The report and accounts having been taken as read, the CHAIRMAN, in moving their adoption, said: Gentlemen, the report speaks for itself, and therefore I won't trouble you with a long speech with respect to it. I think you will agree with me that there is every reason to congratulate ourselves on the working of the past year, and the increase in revenue, which allows us to recommend the payment of a dividend, which is an addition of 3 per cent. on that of the preceding year. I think we ought to call attention to the fact that we have had again to make very large extensions in all our centres—Millbank Street, Eccleston Place, and Davies Street—and you can well understand that the extensive works at these stations have put the working of the business at a great disadvantage. The cost of generating the supply might have been far less if we had not had to contend with these difficulties, which arose in consequence of these extensions to our works. But perhaps, on the whole, it is satisfactory as it is. You will see that the supply of current still continues to increase at a satisfactory rate, and, as far as we can judge, there is no likelihood of a decrease in the number of applications received, for as the old houses in some parts of our district where no electricity is used are pulled down, they are replaced by new buildings, in many places by large blocks of flats, where electric fittings are put in as a matter of course. I think you will agree with me that the negotiations with the holders of the founders' shares has been satisfactory, because there is no doubt that it is to the advantage of all concerned that all the shareholders are now upon the same footing. I think that arrangement is satisfactory to the proprietors generally. I do not think there are any other points I can usefully draw your attention to, but, of course, if any shareholder present has any questions to ask, I shall be most happy to reply to them. I now move the adoption of the report and accounts.

Mr. E. BOULNOIS, M.P., seconded the motion, which was carried.

Mr. J. BROWNE MARTIN then moved: "That a dividend be declared for the past half-year at the rate of 16 per cent. per annum, less income-tax, payable on March 1st, making, with the interim dividend of 8 per cent., 12 per cent. for the year."

Sir DOUGLAS GALTON seconded the resolution, which was agreed to.

Mr. R. W. WALLACE, Q.C., in moving the re-election of Lord Suffield as a director, remarked that he need say nothing concerning the qualifications of his Lordship, who made an excellent chairman, under whom he and his colleagues were very pleased to work.

Mr. HAYES FISHER, M.P., seconded the resolution, and said that outside the work which Lord Suffield did in the board room, his personal influence had been of great assistance to the company in other ways.

The motion was carried.

Mr. WALLACE next proposed the re-election of Mr. Boulnois as a director, and remarked that he did an immense amount of work in connection with the company, and he especially looked after the transfer department.

Sir D. GALTON seconded the proposition, which was agreed to.

Mr. BOULNOIS, in thanking the meeting for his re-election, said he took a pleasurable interest in the proceedings of the company, of which he had been a member since its formation. He had watched its rise from infancy to its present position, and any man might be proud to be associated with a concern which had made such vast strides during the few years it had been in existence.

The CHAIRMAN also thanked the meeting for his re-election, and said that he had always devoted a large amount of attention to the company since he had been on the board. He had been associated with it from the commencement, and it gave him great pleasure to see the progress it had made.

Sir MARK STEWART, Bart., M.P., proposed the following resolution, of which he had given notice: "That the directors shall be paid out of the funds of the company by way of remuneration for their services, the sum of £3,000 per annum, or such other sums as the company in general meeting may from time to time determine, and such remuneration shall be divided among them in such proportions and manner as the directors may from time to time decide" He said he did not think his task would be a very difficult one seeing the prosperous nature of the company. They had something like 180 miles of ways, and they paid something like £50,000 a year dividend, and they had an increasing number of lamps, so that the prospect was that their profits would continue to increase. Ever since the company had been started, it had been progressive. The first year it paid no dividend, but since that time not only had the shares gone up in value, but there had been a steady rise in the dividend. The shares were now four times their original value, owing to the splendid position which the company occupied. He knew the company had got a good district to work, but that would have been no use if they had not been fortunate in obtaining the services of good directors, and he must say that seeing the responsibility that was entailed upon them, they had not justly compensated them for their labours in the past. The increase in the value of the shares and in the dividends had not been by great leaps and bounds, but it had been a steady graduated process, which he hoped would continue. He was anxious to move that resolution a year ago, but was asked not to; but he thought the time had now come when they really ought to increase the remuneration of the board as he proposed.

Mr. F. A. WHITE seconded the resolution, and said he did not think that anybody could say that the present remuneration of the board was fair or reasonable for the amount of work they had to do.

The resolution was agreed to, and the proceedings closed with a vote of thanks to the chairman for presiding.

National Telephone Company.

THIS company's meeting was held yesterday at the Cannon Street Hotel.

Mr. J. S. FORBES proposed the adoption of the report in a lengthy speech, and complimented the shareholders upon the progressive character of the figures in the accounts. Knowing, as the board did, the very great difficulties which surrounded the company, they felt that the profits were very satisfactory. The income had increased over the previous half-year by £67,600, and the expenses by £37,806, so that there was an increased profit balance of £23,474.

The report was adopted.

Dublin United Tramways Company (1896), Limited.

AT the half-yearly meeting, held on the 8th inst. in the Imperial Hotel, Dublin, Dr. William Carte, J.P., presided, and, in moving the adoption of the half-yearly report, gave the following particulars of two companies which they controlled:—The Dublin United Company's results were most satisfactory, showing increased receipts, economic working, and remarkable freedom from accidents. Passengers showed an increase of 1,221,502, representing £5,028, the average fare being 1·39d. for the horse system, and 1d. for the electric; 73,376 additional miles were run. In November last electric traction was introduced on the Clontarf line from Annesley Bridge to Dollymount, with satisfactory results. The speed authorised is 10 miles per hour, and no hitch had occurred. The new power house at Clontarf is built on the most up-to-date system, with best equipments, and in efficiency quite equalled any to be seen abroad. The restrictions as to speed, imposed by the Board of Trade, very seriously affected their receipts on the Dalkey electric system. Unfortunately the Board of Trade had not the power to grant an increased rate of speed, so they had applied to Parliament, and expect, in the coming session, to obtain the same regulations for the Kingstown and Dalkey line as were approved for the Clontarf line. The delay in extending the electric system to Nelson's Pillar, from Haddington Road on the Dalkey line and Annesley Bridge on the Clontarf line, has been unavoidable, owing to the difficulties in arranging with the Corporation. Matters are now, however, settled, and within the next few weeks they hoped to have the electric cars working in to the city. The Rathmines to the sea line is far advanced. They had applied for an Order in

Council to admit of additional lines being constructed in the city and suburbs. Their offer to take over the electric lighting of the city had attracted much public attention. The company considered, from the opportunities at their disposal in being able to use the power stations at night for lighting purposes, they would be in a position to carry out this proposition with advantage to the company and to the ratepayers. But, as it could only be done with the consent and approval of the Corporation, nothing could be done at present. Their application to Parliament for electric powers had been defeated as far as the city and the principal townships were concerned, and the township of Rathmines was promoting a Bill for the expropriation and dismemberment of the tramway system. In considering the present prices of shares they must contrast the position of the company now with what it was at the time when the company was formed. Then they had been unsuccessful in getting electric powers; were threatened with dismemberment by the Rathmines Commissioners; doubts were cast on the titles to our lines; and they were harassed on every side. Since then they had got electrical powers over the whole city and suburbs; they have a certainty of all their lines for 42 years, with 30 per cent. to be added to their then value if the local authorities should decide to purchase the tramways at the end of that period. The public enlightenment on the economy and other advantages of electric tramways had also tended to enhance the price. None of these conditions existed when the company was formed, nor did they seem even probable of fulfilment; and, under all the circumstances, they claimed that they could not have done better for the shareholders of the old company than by securing them in a position which has enhanced the value of their shares by 50 per cent., unless they were prepared for their whole project breaking down at its inception.

Cuba Submarine Cable Company.

The half-yearly meeting of this company was held on Wednesday at the offices of the company. Mr. C. W. Parish, who presided, compared the expenses of the six months under review with those that arose in the similar period of 1896, and the difference was practically £578 in favour of 1897. Alluding to the serious falling off in traffic receipts, which was referred to in the report, the Chairman said that had been principally due to the loss on the French traffic. The shareholders would have been fully prepared for that result, for they were clearly warned last year that the French traffic would eventually go by the new cable from Hayti to New York. A still more serious competitor was the cable between Bermuda and Jamaica, which completed the Bermuda and Halifax route. The chairman then dwelt upon the changes that had taken place since the inception of the Cuba Company, and referred to the loss of income that would accrue to them being compelled to reduce their rates in consequence of the British Government insisting upon a 3s. rate on the New Bermuda line. After referring to a difference that had arisen between their allies, the West India and Panama Company, and themselves, the resolution for the adoption of the report was passed by the meeting.

The National Electric Supply Company.

The ordinary general meeting of this company was held last week at Preston, Mr. H. Booth, J.P., in the chair.

The Chairman, in moving the adoption of the report and accounts, said it was a great pleasure to all the directors to be enabled to recommend a dividend which would be satisfactory to the shareholders. Nearly four miles of additional mains had been laid during the year, and £4,560 was spent on capital account. An alternating plant had been fixed at the works to supply current to Ashton and outlying districts, and an equivalent of 5,000 8-candle-power lamps had been added. The expenses incurred in the reduction of capital had been charged to the revenue account for the year. He hoped that in the future the company would be enabled to materially reduce the price of current to consumers.

Mr. E. Pyke seconded the adoption of the report, and said they looked forward to a very good result for the present year.

The resolution was carried unanimously.

A dividend of 5s. per share to be paid on the ordinary shares was then adopted.

The Epstein Electric Accumulator Company, Limited (in Liquidation).

Mr. P. W. Northey, liquidator, receiver, and manager of this company, has issued the following circular from 28, Victoria Street, Westminster, S.W.:—"As you are probably aware, an action was instituted in the month of July last on behalf of the first debenture holders, and in such action I was appointed receiver and manager and have in that capacity continued to carry on the business of the company. Subsequently, an order was made for the compulsory winding-up of the company, and I was appointed liquidator in such winding-up. An offer has been made for the purchase of the Epstein Company's assets by a new company, which proposes to take over the business as a going concern. The terms of purchase, while not immediately satisfying the entire claim of the first debenture holders (£6,000), give them such interest in the new company, coupled with a guarantee of minimum working capital, that the offer is likely to receive favourable consideration on their part. As to the owners of the second Epstein debentures, these will have the option of applying for fully-paid ordinary shares in the new company, not exceeding in face value the amount of their present holding in second debentures at a discount of 50 per cent. Any such options not exercised by owners will be held at the disposal of other second debenture holders who wish to participate in the new scheme beyond their present holding. The actual assets of the Epstein Company, after collection of outstanding accounts, will be approximately £2,000 in cash, besides:—

	£	s.	d.	
Plant	3,164	17	5	as nominally valued in books on Jan. 1st, 1898.
Stock	3,296	17	11	
Patents	70,050	0	0	

While the before-mentioned offer is under consideration, I desire to invite competitive proposals which may be productive of better results, and I shall be glad to give any desired information with a view to the receipt of ulterior proposals before closing with the one received, which will be open for acceptance till February 26th."

Newcastle and District Electric Lighting Company.

The directors report that the supply of current continues to give satisfaction to the company's consumers, the units sold last year being more than five times the quantity sold in 1890, the first year of the company's operations. The installations connected to the company's mains during the year are equal to 4,400 10-candle-power lamps, bringing the total up to about 32,600, and 642,969 units of electrical energy have been supplied, as against 541,139 units supplied in 1896. During the past year, 3,006 yards of main and branch piping have been laid, together with 4,938 yards of main and branch cable. The gross earnings during the year amount to £5,684 19s. 1d., and after paying interest and making provision for depreciation and reserve funds, the directors are able to recommend a dividend of 5 per cent. for the half-year ending September 31st (less income-tax), which, together with the interim dividend paid in August last, makes the dividend 7½ per cent. for the year.

The Northampton Electric Light and Power Company, Limited.

The annual report to be presented at the annual meeting of shareholders on February 24th, 1898, states that the directors are again able to present a favourable report to the shareholders, notwithstanding several circumstances, but for which the company's progress would have been even more marked. The engineers' strike occasioned much delay and inconvenience, and it is fortunate that no mishap occurred during the busiest season. It became necessary, in view of continued difficulties with the local gas company, to appeal to arbitration on the question of the removal or alteration of gas service pipes, which interfered with the construction of this company's culverts on the safest and most approved plan. The Board of Trade arbitrator has granted the facilities asked for, but at the expense of valuable time, and a resulting loss of revenue. The new system of charging for current has been much appreciated, and will conduce to the advantage of both the company and its customers. The special rebate to consumers during the past year has amounted to no less than £488. The immediate result of this is a loss of income; but the use of electricity for lighting and motive purposes has been so popularised, that the tendency cannot be otherwise than beneficial. The ordinary charge for current is 8d. per unit (less special rebate if shown by the "indicator"); for places of worship 4½d., and for motive power 3½d. (the demand in both cases being at times when the plant is least employed). Discount is also allowed for cash. Further developments are taking place at the company's works. In addition to the two new engines and dynamos referred to in the last report, one more engine of 240 H.P. has been erected, with dynamo complete, making in all six engine and dynamo sets. There has also been fixed a new boiler of a capacity equal to all the three original boilers combined, with an economiser and other subsidiary machinery. Further land and buildings have been acquired, and an additional boiler house has been erected, with a storage tank capable of holding 33,000 gallons of water. A supplemental accumulator battery has been added. The system of supply will be changed over during the present year from two to "three-wire," thereby securing greater efficiency and economy. In view of the increasing demand for current, further plant has been ordered, consisting of boiler, engine and dynamo, all of large capacity. The mains have been extended in several directions during the year. The machinery is maintained in a high state of efficiency.

The balances of the revenue accounts for the past seven years are shown as follows:—

1891	1892	1893	1894	1895	1996	1897
Loss £460	*Profit* £308	£536	£762	£819	£1,351	£1,409
	Less depreciation	...	£100	£250	£500	£500
			£662	£569	£851	£909

(Shillings and pence omitted).

The lamps in use (at 8 C.P. each) during five years have been 4,600, 5,300, 6,130, 8,014, and 11,084 respectively, motive power being accounted for as lamps. It will be seen by the net revenue account that, after paying interest on debentures and temporary loans to the end of last year, there remains £562 13s. 11d. to be dealt with. It is now proposed to pay a year's dividend on all the shares for the year ending December 31st last, viz.: on 6 per cent. preference shares, £232; on 5 per cent. preference shares, £65 3s. 8d.; and on ordinary shares, at the rate of 2 per cent, £201 0s 3d., leaving £64 10s. to be carried forward. Further shares were issued last year, viz.: ordinary shares to the number of 710, and 3,000 5 per cent. preference shares, but the total debenture issue was not increased. It is now proposed to issue 4,290 further ordinary shares at par, and

also to raise £3,950 in 4 per cent. debentures, which will be issued at a small premium. The existing shareholders, debenture holders, and customers of the company will have the first option of taking these shares and debentures.

Messrs. F. H. Thornton and R. Cleaver retire from the board in rotation, and will be proposed for re-election.

The India-Rubber, Gutta-Percha and Telegraph Works Company, Limited.

THE directors' report for the year ending December 31st, 1897, to be presented at the 34th ordinary general meeting of the shareholders, to be held at the Cannon Street Hotel, London, on Wednesday, February 23rd, 1898, at 12 o'clock noon, states that after provision for doubtful debts, a net profit for the past year of £41,044 14s. 9d. Adding £22,128 6s. 4d. brought forward, and deducting £12,500 interim dividend paid in July, there remains a disposable balance of £50,673 1s. 1d. The directors recommend the distribution of a dividend of 15s. a share, free of income-tax, amounting to £37,500, making, with the interim dividend paid in July, a total payment of 10 per cent. for the year, and leaving £13,173 1s. 1d. to be carried forward. There has been little cable work during the year. The company's general business has steadily increased, and the steamships have been moderately employed. The factories at Silvertown and Persan are in a high state of efficiency. There was a six months' strike in the engineering departments at Silvertown, which caused some inconvenience and expense, but did not greatly affect the company's business. The block of buildings in which the Melbourne Agency was situated was burnt out on November 21st. Other premises have been taken and new stock has been sent out.

Mr. Darwin retires by rotation, but offers himself for re-election as a director.

Scarborough Electric Supply Company.

THE report states that the company continues to make satisfactory progress. During the past year 32 new customers, and the equivalent of 2,340 8-C.P. additional lamps have been connected to the company's mains, making a total of 330 customers and 20,067 8-C.P. lamps connected at the present time. To meet these requirements 310 yards of additional mains have been laid, while the capacity in cables and transformers has also been correspondingly increased. An additional 150-kilowatt set of generating plant has also been ordered, but owing to the strike in the engineering trade, is not yet delivered. During the past year electric energy to the amount of 214,044 Board of Trade units has been supplied to customers, at a revenue, including meter rent, of £5,179 13s. 9d., as against 179,360 units and £4,383 5s. 11d. revenue for 1896. The company has made a profit on the year's working of £3,044 13s. 0½d., as against £1,617 8s. 8d. in 1896, adding the balance of £191 19s. 5d. carried from the previous year, there is, after paying income-tax £23 2s. 8d., bank interest £18 8s., and writing off the sum of £ 00, being the balance of the preliminary expenses account, and putting £250 to depreciation, a sum of £1,845 1s. 9½d. available for distribution. The directors recommend that this should be applied in paying a dividend of 5 per cent (less income-tax), which will absorb £1,656 10s., leaving a balance of £188 11s. 9½d. to be carried forward. It will be observed that, in addition to the £100 written off the preliminary expenses account (which is now extinguished), and the £250 put to depreciation account, a sum of £70 1s. 2d. has further been written off the office furniture and fittings upon removal of the offices, making a total of £420 1s. 2d. written off and put to depreciation during the year. Mr. J. W. Woodall, Mr. John Dale, and Mr. J. Bell Simpson retire by rotation, but are eligible and offer themselves for re-election as directors. The auditors, Messrs. Bradley, Davis & Co., chartered accountants, also offer themselves for re-election.

Tramways Union Company, Limited.

A GENERAL meeting of this company was held at Winchester House on Tuesday, Mr. E. M. Underdown, Q.C., presided. In moving the adoption of the report, he said the step they had taken in regard to one of their tramways was extremely important. It would be satisfactory to them to know that in all probability that portion of their system which was intended to be worked by electricity would be in full operation in June. If, as they had not the slightest doubt, the results of this mode of traction proved to be more efficient and profitable, the receipts, which would provide the means of covering the outlay they had incurred for this purpose, would come into account during the remaining half of the coming six months. There had been increases in their expenditure at both Bremen and Bucharest, and the expenditure had not been lessened by the fact that forage had ruled comparatively high in those cities. At Bremen they had practically relaid the system, and otherwise improved it, with results eminently satisfactory. During the current year they would reap the benefit of the improved earnings. The progress of the works at Madrid had been extremely rapid, and the appliances they were putting down there might be confidently said to be of the best and most modern kind. Their colleague, Mr. Concanon, had bestowed the greatest attention on this matter. Among other things he went to the United States, and had satisfied himself that in the arrangements they had made, they had got the very best materials and appliances that could be procured. They all knew the great profit which was obtained by overcoming the mechanical difficulties which arose in the earlier stages of the progress of electricity, and he believed they would be able to work the traffic in Madrid in a very profitable manner.

Mr. GEORGE RICHARDSON seconded the motion, which was unanimously adopted, and a dividend was afterwards declared, making 5 per cent. for the year, tax free.

Eastern Telegraph Company, Limited.

AN extraordinary general meeting of this company was held on Tuesday to consider a resolution to the effect that the regulations of the company be varied by adding the following articles of association, viz.: 85A—"Continuing directors may act notwithstanding any vacancy in their body." The object of the resolution being to provide against the inconvenience arising through the number of directors falling below the *minimum* allowed by the articles of association, and to enable them to carry on the business of the company, including, of course, the filling up of vacancies.

The resolution was adopted.

Stock Exchange Settlements.—The Stock Exchange Committee has (1) appointed special settling days as under:—Wednesday, February 23rd: Cape Electric Tramways, Limited—285,157 vendors' £1 shares, fully paid, Nos. 1 to 285,157; City of London Electric Lighting Company, Limited—Provisional certificates for a further issue of 10,000 ordinary shares of £10 each, £2 paid, Nos. 90,001 to 100,000; Electric Construction Company, Limited—Further issue of 8,657 7 per cent. cumulative preference shares of £2 each, fully paid, Nos. 16,344 to 25,000; Electrical Copper Company, Limited—150,000 6 per cent. cumulative preference shares of £1 each, fully paid, Nos. 1 to 150,000. And (2) ordered to be quoted in the Official List: Barcelona Tramways Company, Limited—Further issue of 5,072 ordinary shares, Nos. 14,929 to 20,000; City of London Electric Lighting Company, Limited—Provisional certificates for a further issue of 10,000 ordinary shares, £2 paid, No. 90,001 to 100,000.

Elmore's French Copper Company.—A circular has been issued to the first mortgage debenture holders of Elmore's French Patent Copper Depositing Company, Limited, which states that the directors have received a proposal, after several weeks' negotiations, for the purchase of the founders' shares of the Société Française d'Electro Metallurgie, which constitute practically the main asset of the company. The sale of these shares will enable the sum of 6s. in the £ to be paid to the first mortgage debenture holders in discharge of their debt. In accordance with the provision contained in the 10th condition endorsed on the said debentures, a meeting of the first mortgage debenture holders will be held at Winchester House on Wednesday, the 23rd inst., to consider the proposal.

The City of London Electric Lighting Company, Limited.—The directors have decided to recommend to the shareholders the payment of the following dividends, subject to the completion of the audit:—On the preference shares 6s. per share for the six months ended December 31st, 1897, making, with the interim dividend already paid, a total distribution of 6 per cent. for the year. On ordinary shares, Nos. 40,001 to 80,000, £1 per share for the year, and on ordinary shares, Nos. 80,001 to 90,000, 10s. 7d. per share for the year, being a distribution at the rate of 10 per cent. for the year ended December 31st, 1897. Both dividends will be payable on March 3rd, 1898.

Brush Electrical Engineering Company, Limited.—The directors have declared an interim dividend at the rate of 6 per cent. per annum on the preference shares for the half-year ended December 31st, 1897, payable on March 15th, 1898. The transfer books will be closed from March 2nd to the 16th, 1898, inclusive.

City of London Electric Lighting Company.—The transfer books and registers of members will be closed from the 16th inst. to March 2nd, both days inclusive.

TRAFFIC RECEIPTS.

The Bristol Tramways and Carriage Company, Limited. The receipts for the week ending February 11th, 1898, were £2,296 3s. 9d.; corresponding period, 1897, £2,120 15s. 5d.; increase, £175 8s. 4d.

The City and South London Railway Company. The receipts for the week ending February 13th, 1898, were £1,058; week ending February 14th, 1897, £1,062; decrease £4; total receipts for half-year, 1898, £7,514; corresponding period, 1897, £7,673; decrease, £159.

The Dover Corporation Electric Tramways. The receipts for the week ending February 5th, 1898, £101 0s. 5d.; total receipts, February 5th, 1898, £538 0s. 8d. The traffic returns for week ending February 12th, 1898, £105 3s. 6d.; total receipts, February 12th, 1898, £643 6s. 2d.

The Dublin Tramways Company. The receipts for week ending, February 11th, 1898, £375 9s. 5d.; corresponding week last year, £433 13s. 5d.; decrease, £58 4s.; passengers carried, 64,846; corresponding week last year, 68,106; aggregate to date, £2,478 5s. 8d.; aggregate to date last year, £2,463 9s.; increase to date, £14 16s. 8d.; mileage open, 8 miles.

The Liverpool Overhead Railway Company. The receipts for the week ending February 13th, 1898, amounted to £1,380; corresponding week last year, £1,219; increase, £161.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending February 11th, 1898, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £5,146.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present issue.	NAME.	Stock or Share. †	Dividends for the last three years. 1895.	1896.	1897.	Closing Quotation, Feb. 9th.	Closing Quotation, Feb. 16th.	Business done during week ended Feb. 16th, 1898. Highest.	Lowest.
137,400£	African Direct Teleg., Ltd., 4 % Deb.	100	4 %	...	...	100 —104	100 104	...	...
25,000	Amazon Telegraph, Limited, shares...	10	...	...	...	6 — 7	6 — 7	...	...
125,000	Do. do. 5% Debs. Red.	100	...	...	...	93 — 96	93 — 96	...	...
923,960£	Anglo-American Teleg., Ltd.	Stock	£2 9s.	£2 13s.	3 %	62 — 64	60 — 62 xd	61	...
3,038,020£	Do. do. 6 % Pref.	Stock	£4 18s.	£5 6s.	6 %	113 —114	110 111 xd	111⅞	110½
3,038,020£	Do. do. Defd.	Stock	...	...	...	13½ - 13⅝	12½ - 13	13⅛	13⅛
130,000	Brazilian Submarine Teleg., Ltd.	10	7 %	...	...	16¾ - 17¼	16⅝ - 17¼	17¼	16 1/16
75,000£	Do. do. 5 %, Debs., 2nd series, 1926	100	5 %	...	...	112 116	112 —116	...	...
44,000	Chili Telep., Ltd., Nos. 1 to 44,000	5	4 %	4 %	...	3 — 3½	3 — 3½	...	...
10,000,000$	Commercial Cable Co.	$100	7 %	7 %	...	187 —192	187 — 192	...	...
653,586£	Do. Do. Sterling 500 year 4% Deb. Stock Red.	Stock	...	...	...	106 —108	106 —108	107½	106⅝
224,850	Consolidated Telep. Const. and Main., Ltd.	10/-	1½%	2 %	...	1/16 — 1/16	1/16 — 1/16	1/8	...
16,000	Cuba Teleg., Ltd.	10	8 %	8 %	...	8 — 9	7⅞ - 8⅛	8⅛	7⅞
6,000	Do. 10 % Pref.	10	10 %	10 %	...	17½ - 18½	17½ — 18½	...	...
12,931	Direct Spanish Teleg., Ltd.	5	4 %	4 %	...	4 — 5	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	...	10 — 11	10 — 11	...	...
30,000£	Do. do. 4½ % Debs. Nos. 1 to 6,000 ...	50	4½%	4½%	...	103 —106%	103 —106%	...	...
60,710	Direct United States Cable, Ltd.	20	2½%	2½%	...	10⅜ - 11½	10⅜ - 11½	11½	10⅞
400,000	Eastern Teleg., Ltd., Nos. 1 to 400,000	10	6½%	6½%	...	18 — 18½	18 — 18½	18 7/16	18½
70,000	Do. 6 % Cum. Pref.	10	6	6%	...	19 — 20	19 — 20	19½	19½
89,900£	Do. 5 % Debs., repay. August, 1899	100	5 %	5%	...	100 —103	100 — 103	...	...
1,302,615£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4%	...	131 —134	131 —134	...	...
250,000	Eastern Extension, Australasia and China Teleg., Ltd. ...	10	7 %	7⅛	...	18⅜ - 19½	18⅜ - 19½	19½	18⅜
25,200£	Do. 5 % (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,849, 3,976 to 4,326	100	5 %	5%	...	99 —.03	99 103	...	...
100,500£	Do. do. Bearer, 1,850—3,975 and 4,327—6,400	100	5 %	5%	...	100 —103	100 - 103	101	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	4%	...	130 —133	130 —133	...	...
51,100£	Eastern and South African Teleg., Ltd., 5 % Mort. Deb. 1900 redeem. ann. drgs., Reg. Nos. 1 to 2,342	100	5 %	5%	...	99 —103	99 - 103	...	...
69,200£	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	5%	...	100 —103	100 —103	...	...
300,000£	Do. 4 % Mort. Debs. Nos. 1 to 3,000, red. 1909	100	4 %	4%	...	102 —105	102 - 105	...	...
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4%	...	108 --111%	108 —111 %	...	...
180,227	Globe Telegraph and Trust, Ltd.	10	4½%	4½%	...	12 — 12½	12 — 12½	12⅝	12⅜
160,042	Do. do. 6 % Pref.	10	6 %	6%	...	17⅞ - 18¼	18 — 18½	18¼	18
150,000	Great Northern Teleg. Company of Copenhagen	10	10 %	10%	...	27 — 28	27½ — 28½	...	...
160,000£	Do. do. do. 5 % Debs.	100	5 %	5%	...	101 —104	101 —104	...	...
17,000	Indo-European Teleg., Ltd.	25	10 %	10%	...	52 — 55	52 — 55	...	...
100,000£	London Platino-Brazilian Teleg., Ltd. 6 % Debs.	100	6 %	6%	...	108 - 111	108 —111	...	...
28,000	Montevideo Telephone 6% Pref., Nos. 1 to 28,000... ...	5	4 %	...	...	2 — 2½	2 — 2½	...	...
484,597	National Teleph., Ltd., 1 to 484,597	5	5½%	5½%	6 %	6⅜ - 7	6⅞ — 7⅛	7⅛	6⅞
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	15 — 17	15 — 17	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	14 — 16	14 — 16	16	...
119,234	Do. 5 % Non-cum. 3rd Pref., 1 to 119,234	5	5 %	5 %	5 %	6 — 6½	6 — 6½	...	...
130,766	Do. do. Nos. 119,235 to 250,000, £5 paid	5	...	...	5 %	6 — 6½	6 — 6½	...	...
329,471£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	104 —109	104 —109	105	...
171,504	Oriental Teleph. & Elec., Ltd., Nos. 1 to 171,504, fully paid	1	5 %	5 %	...	⅝ — ¾	⅝ — ¾	⅝	...
100,000£	Pacific and European Tel., Ltd., 4 % Guar. Debs, 1 to 1,000	100	4 %	4 %	...	105 - 108	105 —108	...	...
11,839	Reuter's Ltd.	8	5 %	5 %	...	8 — 9	8 — 9	...	...
3,381	Submarine Cables Trust	Cert.	...	...	...	140 - 145	140 — 145	...	...
58,000	United River Plate Teleph., Ltd.	5	4 %	...	...	4 — 4½	4 — 4½	...	...
146,733£	Do. do. 5 % Debs.	Stock	5 %	...	...	101 - 106	101 - 106	...	...
15,609	West African Teleg., Ltd., 7,501 to 23,109	10	4 %	nil	...	4 — 5	4⅛ — 4⅜	...	...
213,400£	Do. do. do. 5 % Debs.	100	5 %	5 %	...	103 —106	103 106	...	...
64,268	Western and Brazilian Teleg., Ltd.	15	3 %	2 %	...	10½ 11	10½ 11	10⅞	10 9/16
33,129	Do. do. do. 5 % Pref. Ord. ...	7½	5 %	5 %	...	7½ 8	7½ 8	7 11/16	...
33,129	Do. do. do. Def. Ord	7½	- %	...	...	3½ - 4	3½ - 4	3⅜	3½
382,230	Do. do. do. 4 % Deb. Stock Red. ...	Stock	...	...	...	105 —107	105 —107	...	...
88,321	West India and Panama Teleg., Ltd.	10	⅛%	1 %	...	½ — ¾	½ — ¾	...	...
34,563	Do. do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	...	7⅝ 8½	8 - 8½	8½	8½
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	...	5 - 7	5 - 7	...	...
80,000£	Do. do. 5 % Debs. No. 1 to 1,600 ...	100	5 %	5 %	...	105 108	105 - 108	...	...
1,163,000$	Western Union of U. S. Teleg., 7 % 1st Mort. Bonds ...	$1000	7 %	7%	...	105 - 110	105 —110	...	...
160,100£	Do. do. 5 % Ster. Bonds.	100	5 %	5%	...	100 - 105	100 —105	...	...

ELECTRICITY SUPPLY COMPANIES.

30,000	Charing Cross and Strand Electy. Supply	5	5 %	6 %	7 %	14 - 15	14 - 15	14 5/16	14
20,000	Do. do. do. 4½ % Cum. Pref.	5	...	...	...	6½ - 6⅝	6 — 6¼xd	6⅝	6 5/16
25,000	*Chelsea Electricity Supply, Ltd., Ord., Nos. 1 to 10,277 ...	5	5 %	5 %	...	11¼ - 11⅜	11⅜ - 14¼	12⅛	11⅜
60,000	Do. do. do. 4½ % Deb. Stock Red. ...	Stock	4½%	4½%	...	112 --114	115 —117	...	...
40,000	City of London Elec. Lighting Co., Ltd., Ord. 40,001—80,000	10	5 %	7 %	10 %	28½ - 29½	28½ 29½	29⅜	28⅜
10,000	Do. do. Prov. Certs.	5	...		10 %	27½ — 28½	27½ — 28½	28	...
40,000	Do. do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	17½ 18½	17½ — 18½	17⅞	17⅝
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	5 %	129 —134	129 —134	132	...
30,000	County of Lond. & Brush Prov. E. Ltg. Ltd., Ord. 1—30,000	10	nil	nil	..	15⅝ - 16½	15⅝ — 16½	16½	15⅝
20,000	Do. do. do. 6% Pref., 40,001—60,000 ...	10	6 %	6 %	..	15⅝ — 16½	15⅝ — 16½	16	...
10,000	House-to-House Elec. Light Supply, Ord., 101 to 10,100	5	...		...	10½ — 11½	10½ — 11½	11 1/16	10⅝
10,000	Do. do. 7 % Cum. Pref. ...	5	...		...	11½ - 12	11½ — 12	11⅝	
49,900	*Metropolitan Electric Supply, Ltd., 101 to 50,000 ...	10	4 %	5 %	...	20 - 21	20 — 21	20⅞	20½
12,500	Do. Ord., 50,001—62,500, iss. at £2 prem. ...	10	...	...	...	19½ - 20½	19½ — 20½	...	...
220,000£	Do. 4½% first mortgage debenture stock	...	4½%	4½%	...	117 — 121	117 —121	...	...
6,452	Notting Hill Electric Lightg. Co., Ltd.	10	2 %	4 %	...	18 — 19	18½ - 19½	19½	19
19,980	*St. James's & Pall Mall Elec. Light Co., Ltd., Ord., 101-20,000	5	7½%	10½%	14½%	18½ 19½	18½ — 19½xd	19⅝	18 13/16
20,000	Do. do. 7 % Pref., 20,001 to 40,000	5	7 %	7 %	7 %	10 11	10 — 11 xd	10 9/16	10⅛
50,000	Do. do. 4 % Deb. stock Red. ...	Stock	...	...	4 %	104 —107	107 —110	...	...
43,341	South London Electricity Supply, Ord., £2 paid	5	...	...	...	2⅞ — 3⅛	2⅞ — 3⅛	3	2 1/16
79,900	Westminster Electric Supply Corp., Ord., 101 to 80,000 ...	5	7 %	9 %	12 %	18 - 19	18 — 19	18⅝	18

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.

‡ Unless otherwise stated all shares are fully paid. § Dividends paid in deferred share warrants, profits being used as capital.

Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL, COMPANIES.

Present Issue.	NAME	Stock or Share. ‡	Dividends for the last three years. 1895.	1896.	1897.	Closing Quotation, Feb. 9th.	Closing Quotation Feb. 16th.	Business done during week ended Feb. 16th, 1898. Highest.	Lowest.
30,000	British Electric Traction	10		..	...	17¼ — 17⅜	17½ — 18	17⅝	17¼
90,000	Brush Elecl. Engng. Co., Ord., 1 to 90,000...			..	...	2⅛ 2⅜	2 — 2¼	...	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000				...	2⅛ 2⅜	2⅛ — 2⅜	2⅜	2 3/16
125,000/	Do. do. 4½ % Perp. Deb. Stock.... ..	Stock			...	109 113	109 113	...	...
50,000	Do. do. 4½% 2nd Deb. Stock Red. ...	Stock			...	102 —105	102 —105	...	...
19,126	Central London Railway, Ord. Shares	10			...	10 — 10½	10⅛ — 11	10 15/16	10 5/16
143,106	Do. do. do. £6 paid	10		.	...	5⅜ — 6¼	6½ — 7	6¾	6 5/16
58,830	Do. do. Pref. half-shares £1 pd. ...	..	..	.	...	1¼ — 1⅜	1⅛ — 2	1 13/16	1⅜
61,777	Do. do. Def. do. £5 pd. ...	..	...	..	...	4¼ — 4⅜	4⅜ — 5	4 15/16	4 3/8
630,000/	City and South London Railway	Stock	1⅜ %	1 1/16 %	1 7/8 %	69 71	68 — 70 xd	69	68½
28,180	Crompton & Co., Ltd., 7 % Cum. Pref. Shares, 1 to 28,180		nil	.	...	2¼ 2⅜	2¼ 2⅜	2⅛	...
99,261	Edison & Swan United Elec. Lgt., Ltd., "A" shrs, £3 pd. 1 to 99,261		5 %	5½%	...	2⅛ 3	2⅛ 3 xd	2 1/16	2⅜
17,139	Do. do. do. "A" Shares 01—017,139		5 %	5½%	...	4 — 5	4 — 5xd	...	...
116,000	Electric Construction, Ltd., 1 to 116,000		5 %	6 %	...	2⅜ 3	2⅝ 2⅞	2⅞	2 1/16
16,343	Do. do. 7 % Cum. Pref., 1 to 16,343 ..		7 %	7 %	...	3⅛ 3⅜	3⅛ 3⅜	...	...
91,195	Elmore's Patent Cop. Deposg., Ltd., 1 to 70,000			..	...	⅛ ¼	⅛ ¼	...	..
67,275	Elmore's Wire Mfg., Ltd., 1 to 69,385, issued at 1 pm. ..			..	...	⅜ ⅝	⅜ ⅝	...	..
9,600/	Greenwood & Batley, Ltd., 7 % Cum. Pref., 1 to 9,600 ..		0%	..	...	9 — 11	9 11		.
12,500	Henley's (W. T.) Telegraph Works, Ltd., Ord.	1	8 %	10 %	12 %	22½ 23½	22½ 23½	23⅜	22⅞
8,000	Do. do. do. 7% Pref.	1	7 %	7 %	7 %	19 — 20	19 20	...	..
50,000	Do. do. do. 4½ Mort. Deb. Stock	Stock	4½%	4½%	4½	110 —115	112 117	...	
50,000	India-Rubber, Gutta Percha and Teleg. Works, Ltd. ..	.	%	10 %	10 ¼	22 :3	22 .3	22⅞	22½
300,000	Do. do. do. 4 % 1st Mort. Debs	100			...	103 —107	103 —107	...	...
37,500	Liverpool Overhead Railway, Ord.	1	2¼%	2¼%	3¼	11½ 11⅝	0 15/16 11 1/16	...	...
10,000	Do. do. Pref., £10 paid	1	5 %	5 %	5 %	.6 6½	5⅝— 16½	...	...
37,350	Telegraph Constn. and Maintce., Ltd.	1	5 %	15 %	15 %	39 42	39 — 42	40⅝	...
150,000	Do. do. do. 5 % Bonds, red. 1899	100	5 %	5 %	5 %	2 5	02 —105	...	...
54,000/	Waterloo and City Railway, Nos. 1 to 54,000	1			...	13½ 14	13¾ — 14¼	14⅛	13⅞

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid.

Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

CROMPTON & Co.—The dividends paid on the ordinary shares (which have not a Stock Exchange quotation), are as follows: 1892—0%; 1891—7%; 1890—8%

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

* Birmingham Electric Supply Company, Ordinary of £5 (£4 paid), 7⅞, £5 (fully paid) 11.

Electric Construction Corporation, 6 % Debentures, 105 –107.

House-to-House Company, 4½% Debentures of £100, 108—110.

Kensington and Knightsbridge Electric Lighting Company, Limited Ordinary Shares £5 (fully paid) 16½—17; 1st Preference Cumulative 6 %, £5 (fully paid), 8¼—8½. Dividend, 1896, on Ordinary Shares 7 %.

London Electric Supply Corporation, £5 Ordinary, 4⅝—4¾.

* T. Parker, Ltd., £10 (fully paid), 14¼.

Yorkshire House-to-House Electricity Company, £5 Ordinary Shares fully paid, 8—8½. Dividend for 1896—6 %.

* From Birmingham Share List.

Bank rate of discount 3 per cent. (October 14th, 1897).

COMPARATIVE COST OF STEAM AND ELECTRIC POWER.

III.

THE author is of opinion that electricity is finding it difficult to compete with steam power, or rather to effect a breach in the citadel, because nine-tenths of steam users do not allow a tithe of the constant charges to enter into their calculations of cost at all. They do not, therefore, suspect that their power is costing them so much as it is, and they also believe they are using more power than they really are—using, that is, in its true sense, not wasting it on shafting. It is in small steam plants that the very high ratio of constant charges is found worst developed.

Men who have any idea of what their power costs are very rare indeed. One man is quoted who did know that his 200-H.P. engine operated 6,160 hours a year, cost for everything but rent 2 cents an hour per horse-power on a basis of load factor being unity. But load factors are far from being unity; they are, as a rule, low, and the author tries to trace the line of demarcation on either side of which steam or electric power will be the cheaper to employ. Below 100 H.P. so-called constant loads will have a factor of only ·50 to ·75 on the brake H.P. of the engine.

Three sample cases are taken:—I. Unity load factors; II. High variable power load factors; III. Low variable power load factors. In the estimates the possible saving due to more direct application of power is not taken into account, although, undoubtedly, in cases of very low load factors there can be no doubt but that this is the most important consideration.

Indeed, in a case before us as we write, it happens frequently that the power absorption all the day may never exceed a seventh of a horse-power of current, and this would be running 4 to 5 hours of the day. With steam power, fuel alone would cost at least 2s. a day, and loss of time in the morning would run to an hour, and might affect two to ten men more or less directly. Attention to the boiler would cost either a man's whole wages or a large proportion of them, or it would delay work and call for partial attention of skilled men. Breakdowns and stoppages of small plant are innumerable and an expensive item additional to above costs. Our author estimates the cost of steam plant for an engine B.H.P. of 10, 25, 50 and 100 to be in round numbers £400, £800, £1,150 and £1,800. These are the laid down costs, including buildings, iron stack and all details of engines and boilers of good design. The annual costs per year for insurance, rent, depreciation and interest are respectively £88, £131, £189 and £285. The load factors are now assumed as follows:—Case I., 100 per cent.; Case II., 46 per cent., made up of five hours at 30 per cent., three hours at 50 per cent., and two hours at 80 per cent.; and Case III., load factor of 18 per cent., made up of four hours at 10 per cent., four hours at 15 per cent., and two hours at 40 per cent. As small plants are, as a rule, non-condensing this class of engine is assumed, and for Case I. the four engines will cost in labour as follows:—

The 10-H.P. engine 60 per cent. of a man's time, or £93; the 25-H.P. engine, man's full time or £156; the 50-H.P. engine, man's full time at £187; and for the 100-H.P. engine, full time of engineman and a fireman at £320. These are American figures, of course, the wages of engine and boiler men being rather high in America, on account of the necessary high wages due to cost of living, but the figures are given as for efficient men and are not a minimum. For Cases II. and III., without going into detail, the wages costs are for the four powers, £78, £117, £156, and £187; the cost of oil, waste, and tools being £7½, £15½, £26, and

£40. Allowing ash removal to equal 2½d. per ton of coal, coal to cost 8s. to 16s. per ton, and water about 8d. per 1,000 gallons, the cost of each case can be made up.

REVIEWS.

Lockwood's Builders' and Contractors' Price Book, 1898. London: Crosby, Lockwood & Son.

The new edition of this year book appears to be carefully edited and brought up to date. In the preface it is stated that in the building trade (especially in London) the past year has been an exceptionally busy one. As a consequence prices have gone up, so that the cost of building now is in excess of what it was a year ago. In the electric lighting section of the book reliable guidance is given, and reference made to latest developments. The free wiring system is spoken of, and the method of the Conduit and Insulation Company. The object chiefly aimed at in the information given, is to enable builders to form a correct idea of the probable cost of installing the electric light where current is supplied from a generating station. At the same time the uses are explained of the machinery and apparatus required in the case of private installations. A few names are given of makers of steam engines for driving dynamos, but the possibility of using gas engines for the purpose does not appear to be recognised. The "General Conditions" issued by the City of London Electric Lighting Company are given as illustrating the requirements usually imposed by supply companies.

The Automotor and Horseless Vehicle Pocket Book of Automotive Formulæ and Commercial Intelligence for 1898. London: F. King & Co., Limited, 62, St. Martin's Lane, W.C.

This pocket book has been compiled by Mr. G. H. Little, C.E., and contains a good deal of useful information, a great deal of it relating to the subject of automotors, but a good deal, shovelled in, doubtless, as a fill up, having not the remotest connection with the subject, such, for instance, as the Morse or telegraph alphabet, nautical speed tables, and a fire-stream (fire engine) table. However, in spite of absurdities of this nature, and they are very plentiful, there is very much that has a very direct bearing on the subject, such as "Tractive Data Relating to Cycles," "Ball Bearings," "Chain Gearing," "Liquid Fuel Burners," "The Serpollet Boiler." Doubtless in future editions the really useful matter will be extended and the useless omitted.

Practical Electricity and Magnetism. By JOHN HENDERSON, B.Sc. (Edin.), A.I.E.E. London: Longmans, Green, and Co.

This volume is the second of a series of laboratory manuals by two authors, who jointly sign the preface to the series. Its 390 small pages, openly printed, and freely illustrated, traverse most of the ground of electrical measurement. Explanations of the principles involved are omitted, because, as explained in the preface, they would give the book "unwieldy dimensions; besides, mathematical investigations do not come within the scope of a practical manual, but of a theoretical treatise." The practice of electricity and magnetism, with which the work deals, is the practice of a science school, not of an engineer's laboratory.

The book is not of a kind which recommends itself to a reviewer. Errors of orthography, punctuation, and typography, a deplorable English style, loose and inaccurate statements meet him continually, and give a disagreeable impression of negligence and inexactness. Still, books are not made for reviewers, any more than examinees are made for examiners, and such expressions as "the annunciation," not of a virgin, but "of a law" (the law in question was not Newton's maiden effort), "staunous acid," "analine," do no one any particular harm, while not a few famous philosophers, and indeed journalists, have written infamous English prose. So a student whose general training is wide enough to supply the mathematical demonstrations necessary for the experiments, will probably not be misled by the loose and inaccurate statements of Ohm's law, page 24, or of the swing of a ballistic galvanometer, page 211, by the irregular use of H and H in places where both mean the same thing, or the reason for using a heterostatic method on page 238. Errors in the formulæ of page 195 are, however, more serious.

Apart from such criticism, which we are not disposed to press, the book presents a fairly extensive collection of such methods of electrical measurement as are commonly used in technical schools, and will be useful to many science teachers. The collections of references to recent English scientific papers at the ends of the several chapters is certainly a valuable feature.

THE AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION.

THE seventh annual meeting of the American Electro-therapeutic Association, an abstract of which has recently come to hand, was held at Harrisburg, Pa., in the Academy of Medicine, on September 21st, 22nd and 23rd, under the presidency of Dr. William T. Bishop, of Harrisburg, who called the meeting to order at 10 a.m. on Tuesday, September 21st. The Rev. Leroy F. Baker, of St. Paul's P.E. church, offered an opening prayer, after which Mayor Patterson welcomed the delegates to the city. Dr. Robert Newman, of New York, a former president, responded in a very witty strain, and took occasion to remark that electricity was not treated with the consideration it deserved in the medical colleges.

The privileges of the floor were extended to the many visiting physicians.

Dr. MARGARET A. CLEAVES, of New York, chairman of the committee on meters, presented her report. She drew attention to the fact that several makes of meter had been withdrawn permanently from the tests of the committee because of their demonstrated inefficiency, and that a new company had come into the field with a novel apparatus—a milliamperemeter and a voltmeter for use on alternating current circuits, both sinusoidal and the interrupted or faradic.

Dr. ROBERT NEWMAN, of New York, read a paper on "Electric Treatment in Gout and Uric Acid Diathesis." From careful observation and experience, he could positively assert that gout and kindred diseases could be checked, relapses prevented, and in many cases a cure effected by the judicious application of electricity, particularly the static form. He cited himself as a case in point. The advantages of static electricity are that it is generally diffused through the body, penetrating deeply; it is a general tonic; the "breeze" generally allays the pain in a few minutes, and secures freedom of motion; headaches and mental confusion are dissipated, and the temperature and circulation equalised; the icy coldness of the feet relieved, nervous debility removed, the secretory and excretory organs stimulated, inflammatory products absorbed; it also gives passive exercise. Urinary analyses were presented, verifying the claim for static electricity to abate gout.

Dr. FRANCIS B. BISHOP, of Washington, D.C., presented a paper on "Chorea." It was reasonable to believe that an unstable condition of the higher nerve centres predisposed to the condition, and that a poison affecting these centres might produce in one person epilepsy, in another general neurasthenia, and in a third chorea. In his section of the country malaria was largely responsible for chorea. Treatment consisted in attention to the bowels and diet, securing proper rest, and the use of static electricity by means of the "static cage," which, while gently stimulating the periphery, soothed the general nervous system; at the same time the patient is made to inhale the ozone, thus supplying oxygen to the impoverished blood.

"Sources of Atmospheric Electricity," by Dr. R. J. NUNN, of Savannah, Ga. He considered the solar system a vast static induction machine; the atmosphere close to the earth's surface must revolve with the earth as the latter turns upon its axis, while the tendency of that portion of the atmosphere at a distance from the earth's attraction is to accumulate behind the earth. At some point the atmospheric inertia must neutralise the earth's attraction, and where this occurred there must be friction, which would necessarily cause electrical phenomena; other factors were of importance, such as variation in pressure, temperature, humidity.

"Some Thoughts and Considerations on X Ray Work," by Dr. EUGENE R. CORSON, of Savannah, Ga. The author thought that the experiments on polarisation and refraction had been conducted too close to the tube and that there might be a point at which they would come within the control of present methods. He thought that the X ray would prove even more valuable in dislocations than in fractures. He suggested that a careful outline tracing be made of the negative by transmitted light, all extraneous light being shut off. The eye could much more readily pick out the essential features in such a tracing than from the usual print or radiograph. Radiographs were shown, proving that the X ray penetrated a deposit of urate of soda much more readily than it did bone. Many useful suggestions were made.

"Some Considerations Relative to the Therapeutic Application of the Current," by Dr. GEORGE E. BILL, Harrisburg, Pa. The writer threw out many suggestions as to the best methods of applying electricity, especially as to polarity.

"The Early Electrolysis of Nævus," by Dr. CHARLES R. DICKSON

Toronto, Canada. Two cases were cited in support of the contention that nævus should be operated upon as early as possible, that the operation was much simpler, less prolonged, and the chances of scarring much less than when the operation was deferred until later in life.

"Heart Failure in Cardiac Diseases due to Defective Circulation," by Dr. ELI H. COOVER, Harrisburg, Pa. Many suggestions as to appropriate treatment were made.

"Expenditure of Electrical Energy," by Dr. MARGARET A. CLEAVES, New York. In order to have an intelligent conception of the force by means of which electricity is made available, or of the laws governing its action, it was necessary to use a voltmeter as well as a milleamperemeter. In the treatment of acute neuritis, or acute pelvic inflammation, the wise physician would employ the minimum rate of expenditure in volt-amperes; our purpose is to expend the energy in such a way as to exercise a directive influence upon the molecules and atoms, not to cause any disruptive action. In the treatment of a fibroid tumour on the other hand, greater pressure would be required in order to overcome the resistance of the denser structures in the conducting path; current density in its practical bearings was carefully gone into. Numerous tabulated clinical records were exhibited, containing the data mentioned in the paper.

"Molecular Effects of Electricity," by Prof. DOLBEAR, of Tuft's College, Boston. The laws governing molecular motion were discussed in a masterly manner, physical laws are immutable, and the effects produced by what we call electricity, are really due to heat.

"The New Electro-Mercuric Treatment of Cancer," by Dr. G. BETTON MASSEY, Philadelphia, was a further elaboration of a paper presented to the American Medical Association in June, 1897. It was only applicable in cases where the general system had not yet been infected.

"Current Regulating Apparatus," by Mr. EDWARD JEWELL, E.E., Chicago, described methods of controlling dynamo currents and adapting them to therapeutic work. Absolute protection could only be secured by using the "motor-dynamo," which was made by connecting together by an insulated coupling the shafts of two one-eighth horse-power shunt motors, the winding on one of them having been reversed.

"Report of the Committee on Electrodes," Dr. CHARLES R. DICKSON, Toronto, chairman. A binding post was presented, devised by one of the members, which could be used for any existing tips. The metric system of measurement was again recommended. On motion of Dr. Robert Newman the report was accepted, and on motion of Dr. John Gerin the Association accepted the metric system for all measurements.

"Galvinism as an Aid in the Treatment of Goitre," by Dr. CALEB BROWN, Sac City, Ia. His cases ranged from 12 to 56 years of age, 33 per cent. being "hard" (a preponderance of connective tissue), and 67 per cent. "soft" (a predominance of fluid in the follicles or vascular tissue), every case of the first was benefited, but none completely cured. By galvinism in fully 75 per cent. of recent cases of "soft" goitre, occurring mostly in young women, the gland returned almost, if not quite, to its normal size, and had remained so in 25 per cent. of the cases. Mild currents, frequently repeated, was his rule.

"Further Studies of the Manifestations of Uric Acid, and their Treatment, Electrically and Otherwise," by Dr. J. GRIFFITH DAVIS, New York. Special emphasis was laid on the statement that uric acid and its salts are the result or product of nerve and muscle waste. Among cases cited was one of very severe puerpural eclampsia, followed by a most obstinate form of insomnia, which latter yielded finally most satisfactorily to general faradisation. Among methods of prevention of the retention in the system of uric acid, the bicycle was lauded as a means of obtaining exercise in the fresh air, it was advised that the body be clothed in wool. For acute manifestations the writer preferred medicine, but for the more chronic forms had found the galvanic and faradic currents very useful.

(To be continued.)

THE N.C.S. NEW PATTERN POTENTIOMETER.

IN this potentiometer, which is shown in skeleton diagram by fig. 1 and in general view by fig. 2, all the contacts are made on to the terminals of definite resistances.

The working of the instrument is as follows:—A secondary battery is joined on to the two terminals, F, and sends a current through the two dials, C and D, in series and then through adjusting resistances, K and H. The C dial has 150 exactly equal coils in it, numbered from 0 to 150. The D dial has 100 equal coils in it, the whole dial being exactly equal to one coil in C. The dial, K, contains 19 equal small wire resistances, and H is a carbon resistance for fine adjustment of the current.

A standard cell of known E.M.F. is joined up to A+ and A−, and the switch, L, is put over to A.

Any convenient galvanometer, the most convenient form being a D'Arsonval, is joined up to the galvanometer terminals.

Say the voltage of the standard cell, at the temperature used, is 1·4412; the arm of the C dial is then set to 144, and that of the D dial to 12

The galvanometer key is then depressed on to its first stop (taking care that the catch is underneath so that it cannot go right down) and the outside resistance, K, is adjusted till—with the switch on one

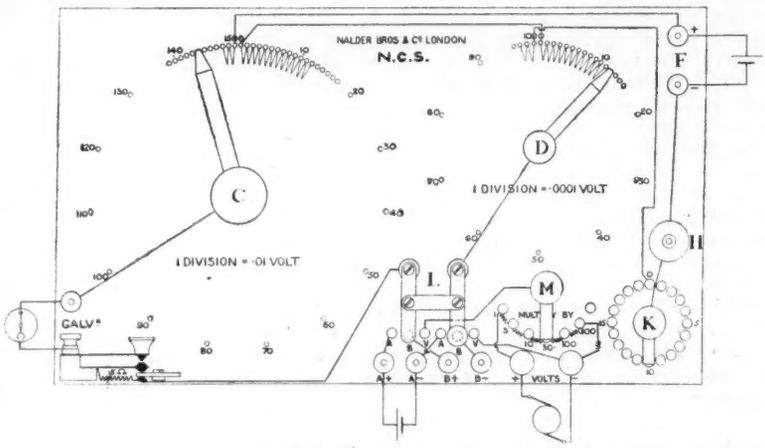


FIG. 1.

stop—the deflection is one way, and, with it on the next, in the opposite direction. The head, H, is then turned until an exact balance is obtained.

The catch on the galvanometer key is then turned aside and the latter depressed fully. This cuts out a ½ megohm which was previously in circuit to protect the cell.

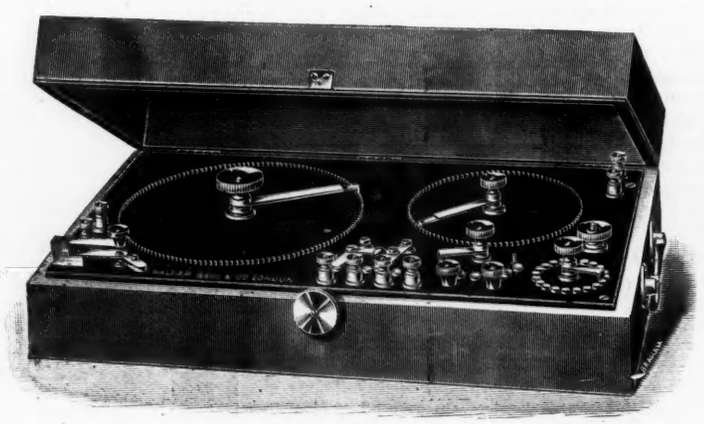


FIG. 2.

An exact balance can now be obtained by further adjustment of H or (if necessary) K.

The result of these adjustments is such that each division on C is now equal to ·01 of a volt, and each division on D is equal to ·0001 volt.

Any low E.M.F. to be measured is joined to B B terminals and the switch L set to B; for example, a Leclanché cell or the terminals of a low resistance for current measurement.

The galvanometer key is then again fully depressed and a balance obtained by moving C and D.

The E.M.F. between B and B is then read direct on the two dials; for example, if the reading on C is 83 and that on D is 67, the volts between B and B is ·8367. Any volts higher than 1·6 have to be measured on the terminals marked volts + and −, and with the switch, L, turned to V. The switch, M, is then turned to any convenient multiplying power, 3, 10, 30, &c, and the readings obtained from C and D (when the balance is obtained as before) has to be multiplied by this multiplying power; for example, if C is 103 and D 26, and M is standing at 30, the volts on the terminals are 1·0326 × 30 or say 30·98.

The resistances in H and K are arranged so that any voltage up to three volts can be used at F, thus allowing either a secondary cell or two large Leclanché to be used.

THE COST OF ELECTRIC ENERGY PRODUCTION.

In connection with the many references to this subject that we have recently made, and more particularly in regard to the supply of electric energy from lighting stations for tramway purposes (see the Electrical Review, January 14th last, page 36), some interesting figures and estimates have been sent to us by Mr. Shallcross, of the Birkenhead Electricity Works, to show that it is not only possible, but quite easy for such stations to profitably supply current at 1½d. per unit for tramway work.

Our correspondent assumes station plant of an output equal to, say, 1,500 H.P.—which is quite a fair average for an ordinary large tramway system—and shows how, on the basis of long hours' consumption per day, an excellent profit can quite well be obtained, not merely at full load for the generating plant throughout the working day, but also when it is considerably underloaded.

Thus, a plant of the size mentioned, working for 18 hours per day—not an excessive daily period at all for tramways—would only be working at a little less than half load if it produced 2,000,000 units per annum.

The cost of this output our correspondent sets forth as follows:—

	£
Coal (10s. per ton)	1,859
Oil	100
Water	293
Wages, &c.	910
Repairs and maintenance	1,250
Interest and sinking fund	1,500
Insurance and sundries	200
	£6,114

and the revenue at 1½d. per unit metered, *i.e.*, allowing for losses in mains, &c., amounts to £10,416, leaving a balance of profit equal to £4,302.

When the generating plant is worked at full load for the whole 18 hours daily, as might readily be done through the use of storage batteries in the main or sub-stations, the proportion of profit becomes still greater, and our correspondent's figures then may be set out as follows:—

Total output, 5,584,500 units per annum. Cost:—

	£
Water	864
Coal	5,499
Oil	100
Wages	1,066
Repairs and maintenance	1,250
Interest and sinking fund	1,500
Insurance and sundries	200
	£10,480

and the revenue at 1½d. per unit, allowing for losses, &c., as before, amounts to £24,723, leaving a balance of profit equal to £14,243.

Without pledging ourselves in any way to the exact accuracy or completeness of our correspondent's figures, we may at any rate emphasise them as showing how important it is for municipalities and others, who are thinking of supplying current for tramway purposes, to bear in mind the long hours of supply, and the great difference which this makes in the net profits. The second instance which he gives would appear to show that energy might be generated by the tramway undertaking itself at a cost of ¾d. per unit. It is hardly fair, therefore, to expect so much higher a price for current from a municipal station than what it would cost when generated by the tramway company.

THE DIRECT TRANSFORMATION OF HEAT INTO MECHANICAL WORK BY THE EMPLOYMENT OF ALLOYS OF FERRO-NICKEL.

By MARCEL DEPREZ.

In a recent article* I showed how the magnetic properties of the alloys of iron and nickel can be utilised for producing an electromotive force, undulatory in form, and I said that I would indicate the conditions under which these properties would be capable of giving practical results. A deep study of the question has led me to the conclusion that if these results are ever obtained great difficulties will have to be overcome, the nature of which will be explained in this article. Instead of the problem we had in view we propose to turn to account the thermo-magnetic properties of the same alloys to obtain an available mechanical work.

I.

We will suppose that in a uniform and permanent magnetic field has been placed a rod of ferro-nickel, moving round an axle passing through its centre perpendicularly to it, and also to the lines of force of the field. Left to itself, the rod will immediately place itself in the direction of the lines of force, and if we displace it, it will tend to return, developing a couple the value of which is given by the equation:

$$\mathrm{c} = \mathfrak{M} h \sin\theta$$

in which $\mathfrak{M}$ represents the magnetic momentum of the rod subjected to the inductive intensity of the field of intensity h and θ, the angle which it makes with the lines of force.

$\mathfrak{M}$ is a function of θ, for the magnetising intensity of the rod is smaller in proportion as the angle which it makes with the lines of force is greater, and when θ attains a value equal to $\frac{\pi}{2}$ (*i.e.*, when it is perpendicular to the lines of force) we see at once that the rod cannot receive any magnetisation, and that according as it deviates very slightly to one side or the other of this critical position, the sign of its magnetisation is changed.

The nature of the function that connects $\mathfrak{M}$ with θ is unknown to us, but we will suppose that the value of $\mathfrak{M}$ remains constant while the rod, leaving the position of unstable equilibrium at which its magnetisation is *nil*, describes a right angle and places itself in the direction of the lines of force of the field producing mechanical work. In order to place ourselves under the most favourable conditions possible, we will assume that during this angular displacement the value of $\mathfrak{M}$ is constantly equal to that which corresponds to the position of equilibrium established when the direction of the rod follows the lines of force. It is easy to see that under these conditions the mechanical work, $\mathfrak{T}$, developed while the rod describes a quarter of a revolution is expressed by $\mathfrak{T} = \mathfrak{M} h$.

The rod being thus brought to its position of stable equilibrium, we will raise its temperature until it completely loses its magnetic properties, and we will make it describe another quarter of a revolution in the same direction so as to bring it into the position perpendicular to the lines of force of the field; we will keep it still and cool it until it regains all its magnetic properties. It is then ready to go through again the cycle of operations that we have just described. Designating by $\mathfrak{I}$ the intensity of magnetisation of the rod and by υ its volume, we get

$$\mathfrak{M} = \mathfrak{I}\,\upsilon; \text{ whence } \mathfrak{T} = \mathfrak{I}\,\upsilon\,h.$$

On the other hand if we call τ_0 and τ_1 the initial and final temperatures of the rod, and c the specific heat of the alloy of ferro-nickel, m the specific volume, the quantity of heat which must be supplied to the rod and which must then be withdrawn from it in order to describe a cycle of operations is expressed by:

$$\mathfrak{Q} = c\,m\,\upsilon\,(\tau_1 - \tau_0).$$

The value of the work produced per unit of heat is therefore:

$$\frac{\mathfrak{T}}{\mathfrak{Q}} = \frac{\mathfrak{I}\,h}{c\,m\,(\tau_1 - \tau_0)}.$$

We see that it is greater in proportion as the intensity of magnetisation and the magnetic field are themselves greater.

Iron, steel, and cast-iron have been subjected to many experiments, having for their object the determination of the values of $\mathfrak{I}$ as a function of h; but unfortunately it is not the same for the alloys of iron and nickel studied by M. Guillaume, and we must content ourselves with hypothetical values which we will choose, letting ourselves be guided by the single consideration that nickel is considerably less magnetic than iron. We will assume, then, that the maximum of $\mathfrak{I}$ is about 1,000 C.G.S. units, whereas that of soft iron is equal to 1,500, unless the inductive field possesses an extremely high intensity and becomes, in consequence, difficult and costly to produce.

This last consideration will lead us to adopt for the inductive field a moderate intensity, which we will fix at 1,000 gauss.

As regards the factors which enter into the denominator of the second term of the equation, which gives $\frac{\mathfrak{T}}{\mathfrak{Q}}$, we will assume the following values:

$$c = 0{\cdot}12,\ m = 8,\ \tau_1 - \tau_0 = 50°.$$

We thus get for the value of the mechanical work (expressed in ergs) produced by an expenditure of heat equal to a small calorie:

$$\frac{\mathfrak{T}}{\mathfrak{Q}} = \frac{0{\cdot}12 \times 8 \times 50}{1{,}000 \times 1{,}000} = 20{,}800 \text{ ergs.}$$

The mechanical equivalent of a small calorie being equal to 41,690,000 ergs, we see that the available mechanical work would only represent $\frac{1}{2000}$th of the work equivalent to the quantity of heat expended. Now *the worst steam engines* consuming 30 kilogrammes of steam per H.P. hour transform into work $\frac{1}{15}$th of the available heat; they have, therefore, an efficiency nearly 80 times as great as that which we have just found.

This is not all; to make a motor of one steam H.P., we must furnish each hour to the magnetic alloy a quantity of heat equal to that which represents theoretically the work of one H.P. during this period of time (635 large calories), multiplied by the inversion of the fraction, $\frac{\mathfrak{T}}{\mathfrak{Q}}$, or 1,270,000 large calories.

But this number only represents half the flow of heat that must pass through the magnetic parts that are alternately heated and cooled, for after a certain quantity of heat has been supplied to these parts in order to get rid of their magnetic properties, it has to be taken away in order to make these same properties disappear, and these changes of temperature must take place in a much shorter time than that which represents the duration of a cycle if we would not lower considerably the feeble efficiency that we have just found. Thus it is not the movement of 1,270,000 large calories per hour that would necessitate the production of one steam horse-power, but twice that quantity or 2,540,000 calories: and the duration of these changes of heat should certainly not exceed a quarter of the time

* *Comptes Rendus*, Académie des Sciences, October 11th, 1897, p. 511.

required for the production of the mechanical work, or the efficiency will be considerably weakened, as I have said before, because if the heating and cooling were not almost instantaneous, the work produced by a given displacement of the magnetic parts would have a lower value than that calculated. It would therefore be necessary to use heating and cooling processes of extreme energy, of which we can form an idea by comparing them with what takes place in locomotives, where *a square metre* of heating surface gives passage to about 200,000 calories an hour at the most.

Thus, briefly, with the hypotheses we have assumed, the production of one steam H.P. of work would require an expenditure of 1,270,000 calories of heat per hour, which would be equivalent to the total quantity of heat produced by the burning of 150 kilos of coal.

II.

The results of these calculations are of a nature to lead us to abandon all hope of turning to account the very remarkable properties of the alloys of ferro-nickel as far as their application to the transformation of heat into mechanical work is concerned. I am, however, going to show that they may be considerably improved: 1st, by increasing the intensity of the magnetic field; 2nd, by employing a particular method of heating and cooling; by making the body which serves as a vehicle for the heat pass successively over a series of rods made of alloys in which the percentage of nickel varies according to a law determined by means of the formula (furnished by M. Guillaume)* We will now examine these three ways of increasing the efficiency.

The Augmentation of the Intensity of the Magnetic Field.—The mechanical work developed during a cycle being in proportion to the intensity, h, of the field, whereas the quantity of heat necessary to effect the disappearance of the magnetic properties of the alloys of ferro-nickel is to all intents independent of it, we may say, without making any appreciable error that the economic efficiency is in proportion to the intensity of the field.

Therefore, if this intensity amounted to 10,000 units instead of 1,000, the efficiency would be multiplied by 10. This intensity of 10,000 units, although very high, could be attained without requiring the use of any extraordinary methods, but it is certain that it could not be obtained with simple permanent magnets. However, we purposely abstain from taking into account the expenditure of energy that it will necessarily entail.

2. *Methods employed for Supplying or Withdrawing the Heat from the Magnetic Alloy.*—We have seen that, with the efficiency of $\frac{1}{2000}$, the production of a power of 1 steam H.P. would necessitate the employment of methods of heating and cooling of extreme energy. If the efficiency were brought to $\frac{1}{200}$ by employing a field of 10,000 units, the quantity of heat that would have to be supplied to, or withdrawn from, the magnetic alloy, would evidently be $\frac{1}{10}$ of that required in the former case; but its value would still be so great that we could not reasonably expect to obtain it directly from the products of combustion, on account of their low specific heat per unit of volume. The heating, and also the cooling, of the magnetic mass must be almost instantaneous. Now there is only one process that enables us to supply or withdraw from a body of small volume a considerable quantity of heat in a very short time: this is to bring it into contact with a liquid considerably hotter or colder than itself, and, moreover, to divide the body into thin plates or into wires of small diameter so as to increase as far as possible the ratio of the surface exposed to the changes of temperature to the volume of the body. This method, moreover, enables us to vary the temperature of the body alternately between two determined limits without any considerable consumption of heat, unless, however, its specific heat is not a function of the temperature alone (and this is what takes place when the body produces mechanical work). This is, moreover, the principle of the regenerators of heat formerly used in hot air engines. But, for this process to give the economic results required of it, the following conditions must be fulfilled:—(1) The body that is to be heated or cooled must not conduct the heat in the direction of the movement of the liquid, so that its temperature decreases according to a logarithmical law in the direction of the movement without its different parts tending to place themselves in equilibrium of temperature; it should, on the contrary, conduct in a direction perpendicular to the movement of the liquid. (2) We must avoid all causes of disturbance in the liquid so that the layers that are affected by the same movement should have no tendency to mix and place themselves in equilibrium of temperature. (3) A definite relation should exist between the mass of the thermo-magnet, the extreme limits of temperature that cause its magnetic momentum to vary, and the quantity of liquid set in motion during one cycle. If this relation is not observed, a great diminution of the useful effect might result. The two first conditions are easy enough to fulfil by forming the thermo-magnet of a series of plates of very slight thickness, with a breadth of 10 to 15 millimetres in the direction of the movement of the liquid, and separated from one another by an interval of 2 to nearly 3 millimetres.

Lastly, in order that the displacement of the thermo-magnet in the magnetic field should be slight while the changes of temperature are taking place, it will probably be necessary to impart to it an alternating movement like that of the piston in a steam engine; the changes of heat would then take place at the ends of the stroke. The circulation of the liquid would be alternating and would be controlled by a piston set in motion by a handle fixed at right angles on the motive handle.

3. *The Simultaneous Employment of Several Thermo-magnets Working at Different Temperatures.*—Is Carnot's principle applicable to the phenomena brought into play in the thermo-magnetic motor? It is extremely probable, as, up to the present, the conclusions that have been drawn from it when it has been applied to the study of the various manifestations of energy, in which there is a transformation of heat into mechanical work, have always been verified. If it is so in the present case the economic efficiency of the thermo-magnetic motor can only attain a high value on condition that the limits of temperature between which the thermo-magnet oscillates in order to completely, lose or recover its magnetic properties shall be as far apart as possible. Now the interval between them, in the case of the alloys of ferro-nickel, is only 50°; but by varying the proportion of nickel, the absolute value of the extreme temperatures can be modified at will, their difference remaining always equal to 50° We can thus, with the aid of M. Guillaume's formula, arrange the percentage of nickel in a series of alloys so that the richest of them shall lose its magnetic properties at 350° and recover them completely at 300°, whereas a second alloy will lose them at 300° and recover them at 250° and so on. We arrive thus at the last alloy of the series for which the extreme temperatures will be 150° and 100°. The fall of temperature of the liquid will thus amount to 250° and the efficiency will be five times as great as if only the first of the alloys were used. We could even go lower than 50° and realise an alloy, the cycle of which would be comprised between 100° and 50°.

This process would, therefore, enable us to increase six-fold the economic rendering of which we gave the value at the commencement of this article; as, besides, this same efficiency can be multiplied by 10, by employing a magnetic field of 10,000 units we see that the coefficient $\frac{1}{2000}$, the value of which we gave at first as representing the fraction of the heat displaced transformed into work, would become $\frac{10 \times 6}{2,000} = \cdot 03$, even *if we did not employ* the mode of heating and cooling described above.

III.

In short, we see that, if it is not impossible to utilise the curious thermo-magnetic properties of the alloys of ferro-nickel for transforming heat into mechanical work, very great difficulties will have to be overcome in order to obtain really practical results.

The question of the direct transformation of the heat into electrical work has a close connection with the one now under consideration, but it is much more difficult to treat it directly; it is, moreover, almost evident that the conclusions at which I have just arrived apply equally to this second mode of transformation. I must observe that this is not the first time that it has been proposed to utilise the thermo-magnetic properties of either iron or nickel, for transforming heat into mechanical or electrical work. Edison has tried to solve this problem,* using the property that iron possesses of ceasing to be magnetic at about 750°. But none of the conditions necessary either for obtaining a practical economic efficiency or for ensuring the rapidity of the changes of temperature were fulfilled. M. Nodon wrote to me after the publication of my first note on this subject, that he had in 1890 sent a sealed packet to the Académie des Sciences, in which he described a process consisting of the employment of a metallic gauze of pure nickel serving to close a magnetic circuit. This metallic gauze was alternately heated and cooled by means of a current of air, and the variations in the flow of magnetic force which resulted from the variations of temperature thus produced served to generate an alternating current.

* Given in my note to the Académie.

THE INSTITUTION OF ELECTRICAL ENGINEERS.

An Electrolytic Process for the Manufacture of Parabolic Reflectors.† By Sherard Cowper-Coles, Member, Assoc.M. Inst.C.E.

Glass mirrors at the present time are almost exclusively used for projectors for search lights and similar purposes, on account of the difficulty that has been experienced in producing a true metallic reflector that will not readily tarnish when exposed to the heat of an arc light. One advantage of a metallic reflector is that the rays from the carbon points are collected into a parallel beam by means of refraction only, and is not catadioptric, as most glass mirrors are. Spun reflectors are never true, as it is found in practice impossible to spin them quite true to the moulds. Experiments have been made with a view to substituting cast metal for glass, but the cost of grinding and polishing, and the unsatisfactory surface that is obtained, have resulted in the attempts being abandoned. Stamped reflectors have also been tried, but with no more satisfactory results. The present process I propose to describe to you is an electrolytic one, one of the chief features being that the surface produced requires no after polishing or trueing up. When once a true mould has been produced, any number of reflectors can be taken from it at a nominal cost. A glass mould is prepared, the convex side of which is accurately shaped and polished to form a true parabolic, or other reflecting surface. As the mould only requires shaping and polishing on the convex side, it is comparatively cheap as compared to a glass reflector, which has to be ground on both sides. On the prepared surface is deposited a coating of metallic silver, which is thrown down chemically on the glass and then polished, so as to ensure the

* *La Nature* published in 1888 an article in which we find the methods used by this scientist described.

† Abstract of Paper read on Wednesday, February 9th, 1898.

copper backing being adherent to the silver. The mould thus prepared is placed in a suitable ring and frame (which I will describe later on), and immersed in an electrolyte of copper sulphate, the mould being rotated in a horizonal position, the number of revolutions being about 15 per minute. The copper adheres firmly to the silver, and together they form the reflector, which is subsequently separated from the glass mould by placing the whole in cold or lukewarm water, and then gradually raising the temperature of the water to 128° Fahr., when the metal reflector will leave the glass mould, due to the unequal expansion of the two. The concave surface of the reflector obtained is an exact reproduction of the surface of the mould, and has the same brilliant polish, and requires no further treatment to answer all the purposes of a reflector, with the exception that it must be coated with a film of some suitable metal to prevent tarnishing. Palladium is found to answer this purpose best, as a bright coating can be deposited rapidly to any desired thickness; the palladium resists tarnishing and the heat of the arc to a wonderful degree.

Palladium is a silver-white hard metal, and is sufficiently ductile to be rolled into thin sheets. Its specific gravity is about 12, being half that of platinum. The present price of palladium is about double that of platinum, but, its weight being one-half, the same area can be covered at the same cost. It melts at an extremely high temperature —about the same as wrought-iron. When only slightly heated in hydrogen gas, it has an extraordinary power of absorbing mechanically large volumes of this gas. Graham investigated this very curious phenomenon, and found that a piece of palladium foil, when heated below 212° Fahr., takes 240 times its volume of hydrogen, but that it had not the power of absorbing oxygen or nitrogen. At a moderately high temperature palladium assumes a blue colour, and the formation of a thin film of oxide, which it loses at a higher temperature, due to the decomposition of the oxide. Palladium is not readily attacked by sulphuric or hydrochloric acid.

In carrying out the manufacture of reflectors by this process, it is essential that the glass mould be perfectly clean and free from grease before the silver coating is applied. It has been found, however, that, if the cleaning is solely effected by chemical means, there is a great liability of the silver adhering too firmly to the glass, whereby the mould is in danger of being broken during the removal of the reflector. This difficulty has been overcome by cleaning the glass mould with a suitable paste or powder, such as peroxide of iron, then removing such paste or powder by washing the glass with a 50 per cent. solution of ammonia. It is necessary that this cleaning operation be repeated prior to the production of each reflector. After the convex side of the mould has been properly cleansed as described, a thin coating of metallic silver is applied as follows: Ammonia is added to a solution of nitrate of silver until the precipitate that is first formed is re-dissolved, then re-precipitating by caustic soda, again dissolving in ammonia, then adding glucose to the solution. Excellent results have been obtained with a silvered solution of the following components, equal parts of each being used:—Silver nitrate, 0·5 per cent.; caustic potash, 0·5 per cent.; glucose, 0·25 per cent. The surface of the mould to be coated is immediately dipped into the solution, when it becomes coated with a film of silver. The silver coating is thoroughly washed, and then allowed to dry, and the silver which has been deposited is burnished bright with a piece of cotton wool and peroxide of iron, preferably precipitated by ammonia from a dilute solution of ferrous sulphate. The cost of the silvering is found to vary from 2d. to 4d. per inch diameter. I have here a film of the silver and copper stripped from a glass mould, which is quite transparent to transmitted light, having a green tinge, but is capable of reflecting light.

The copper solution generally used is of the following composition:—Copper sulphate, 13 per cent.; sulphuric acid, 3 per cent.; water, 83 per cent. As soon as the requisite thickness of metal has been deposited, the mould, with the reflector attached to it, is placed in a bath of cold or lukewarm water, which is then raised to a temperature of 120° Fahr.; whereupon, owing to the difference of the expansion of the glass mould and the metal backing, the latter separates from the mould. The only thing that requires to be done now is to coat the reflector with an untarnishable metal. This is accomplished by placing the reflector in an earthenware pan, containing a 0·62 per cent. solution of palladium ammonium chloride in about a 1 per cent. solution ammonium chloride. The solution is used at about 75° Fahr., the current used for a 2-foot reflector being about 0·5 of an ampere, the E.M.F. at the terminals of the bath being 4 to 5 volts. An anode made out of carbon, and curved approximately the shape of the reflector, is attached to a rod, which is connected by an arm to a rotating disc which causes the anode to swing to and fro, thereby ensuring an even coating of palladium, and agitating the solution and preventing the depositing upon the reflector of particles of foreign matter which may be present in the solution.

The back of the reflector is usually varnished before placing it in the bath, to prevent local action setting up between the copper and the silver or palladium. The reflector is removed from the bath and dipped in boiling water, and then placed in boxwood sawdust, which is kept hot by means of a steam jacket. The reflector is then ready to be mounted in a suitable ring.

Reflectors made by the process which has just been described have been subjected to a number of tests, and found to withstand excessive heat without tarnishing. Salt water has been thrown on the reflectors when they have been too hot to touch, the result being that the water was driven off as steam, and the salt left as a white deposit on the reflector, which was easily removed with a wet cloth.

A reflector recently tested at Portsmouth had a number of rifle bullets passed through it, when the beam was found to be little affected. On the other hand, the first shot fired at a glass reflector splintered it to pieces.

Although palladium does not reflect light as well as a silver surface which is perfectly clean and bright, silver is found quite unsuitable, as after being in close proximity to an arc light for a short time the silver tarnishes, and the light is greatly reduced in intensity. With a palladium-faced reflector the intensity of light is found to remain practically constant, as little or no tarnishing takes place.

THE SOCIÉTÉ INTERNATIONALE DES ELECTRICIENS.

THE usual monthly sitting of the Société des Electriciens took place February 2nd, 1898, with M. Violle in the chair. M. G. Janet, in consequence of a death in the family, could not read his paper on "The Temperature of Incandescent Lamps."

M. BRANLY called attention to the fact that various experiments had been made in producing continuous or intermittent electric waves, transmitting them to a distance, receiving them, and registering them. The transmitter is a Hertz oscillator, with two spheres immersed in an insulating liquid. This oscillator is worked by a little Ruhmkorff coil, placed in a box lined with metal, and provided with a contact key for obtaining short or long discharges.

The Hertz spark resonator is replaced by a tube of iron filings. The latter, which are enclosed in a tube, and placed between two conductors, and which form a circuit with a battery and a galvanometer, offer a great resistance to the passage of the current; they become conductive when excited by an electric wave. This conductivity is destroyed by a shock, to reappear when a fresh wave strikes the tube. The sensibility is very great, and manifests itself at a distance. In 1895 M. Popoff had an apparatus constructed for receiving and registering electric waves. The receiver is a tube of iron filings placed in circuit, with a battery and a relay. The latter is put in motion as soon as the tube is struck by an electric wave at a distance. M. Branly referred to his experiments in connection with the paper read at the last sitting by M. Voisenat on "Telegraphy Without Wires."

M. BOUCHEROT then read a paper on "Industrial Condensers: on their Employment in Distributions at a Constant Intensity, and on a Self-exciting Alternator."

In industrial condensers, the quality of paper used is an important consideration. Some kinds of paper heat and keep together, others do not heat, but easily crack. The specific resistance of the paper varies from 1 to 3 megohms per centimetre.

The temperature should also be considered. In some measurements taken between 20° and 100°, M. Boucherot obtained for the insulation resistance of various condensers—for oil, 3,500 ohms at 95° and 1·45 megohms at 17·1°; for paraffin, 500,000 ohms at 99° and 10 megohms at 17°; for oiled paper, 150,000 ohms at 44°, and for paraffined paper 6 megohms at 40°. A paraffined paper condenser gave an insulation resistance of 2·6 megohms at 37°, of 700,000 ohms at 50°, and of 100,000 ohms at 80°. To obtain good working from a condenser, we must not, at present, exceed a difference of potential of 800 volts.

Various experiments have shown that, on alternating current systems, the difference of potential rises to values above the normal and pierces the condensers. We can now make condensers for 40 periods per second at 3,000 volts, at the rate of 100 francs the kilowatt, and at 100 volts for 150 francs the kilowatt. For 50 periods per second, we must reckon at 3,000 volts 50 francs the kilowatt, and at 100 volts 75 francs the kilowatt, but condensers are only advantageous for low powers.

M. Boucherot then showed the advantages of condensers, first, for counteracting the effects of self-induction, and then for distribution at a constant intensity. On an effective difference of potential is branched a circuit formed of a self-induction coil and a capacity. We can then place in derivation, either at the terminals of the condenser or at the terminals of the self-induction coil, a circuit formed of various apparatus in series. The intensity remains constant in the circuit.

The writer then discussed various other cases, and made some experiments for purposes of demonstration. In conclusion, he spoke of a self-exciting alternator, but he merely gave a brief sketch of its principle.

M. KORDA then said that some condensers had already been constructed at Buda-Pesth with an insulator of oil in vacuo.

THE ENGINEERS' STRIKE.

As the results of the men's ballot came in, they showed in favour of acceptance of proposals 28,588 and against 13,727, a more than two-thirds majority. The terms of settlement being formally agreed upon, it was arranged to resume work on Monday, January 31st. There was a good deal of kicking against the inevitable, and talk about a general organisation. This, we are certain, will for long be impossible, except some entirely new actuarial basis be built upon, with proper division, by hard and fast lines, of the funds for fight and for benefit. In its late existing form the Amalgamated Society of Engineers is a total wreck. Never was a trade struggle carried on with less turmoil and strife, and never has so huge a struggle terminated so disastrously for its originators. The men have secured

nothing by the struggle. They have not even gained any recognition for even fancied principles. True, certain hitherto accomplished aims have been specifically named in the agreement, but to them have been tacked equally specific limitations not hitherto allowed a right in trades union ideas. Militant unionism has been set back to a line far in the rear of its previous outposts, and the line is fortified by the employers who have mounted guns on previously dismantled positions. Everything now depends upon the amicable working of the men under new conditions, and upon the determination of the employers to insist on a day's work for a day's pay, and to keep their plant up to modern conditions.

Labour will then begin to profit by the change and by the regaining of lost trade, and we fully believe that with these things thoroughly carried out the eight hour day will come to be general. A really earnest day of eight hours will be better for everyone than the half-hearted nine hours' day, which we hope has ceased to be. The estimates as to the proportion of the locked-out men that could be taken on again varied considerably for different towns. At one place hardly any, at another 75 per cent., and the remainder in a few weeks, were reported as probable.

In this last ballot of the men the smallness of the numbers voting is remarkable. At Paisley, Blackburn and Leeds, Dundee, Wigan and Keighley, the majority of votes were cast against returning to work, whereas in London, the place of the original mischief, the men wanted to go back to work. This sort of thing must annoy the men of the north, who, having taken up the battle for London, find themselves sold by the London executive, who, a short time ago declared they had funds to go on fighting indefinitely, and yet hardly had funds to meet weekly engagements. The hope of supplies had, in fact, kept men fighting to the last ditch, and there, figuratively, they were left while Mr. Barnes cynically abandoned them to their fate, as having no choice. The great change which the strike has shown to be coming upon the engineering trade is specially made plain in the case of a firm which finished two steamers by the aid of apprentices only, the steamers passing the trials and tests as up to standard. Why, with all the facts before them, the executive allowed the fight to go on upon the mere formality of a formal recognition by the employers of the notes appended to the clauses of the agreement, it is difficult to say. The notes were the notes of the employers, and would be cited, whether formally recognised or not, in the future. Probably the truth is that Mr. Barnes hoped by refusing the clauses to force public opinion in favour of the men, in which he lamentably failed. He then seized upon the notes, and asked the masters to say over again what they had already pledged themselves to. This delay has done trades unionism no good. Nothing more has been obtained, but only the nakedness of the treasury has been shown up and a defeat has been converted into a rout, for the men could have far better gone to work direct from the conference, while every day's delay has shown up the hollowness of the cry of the skilled man as necessary in machine production.

Finally, we should like to say a word as to the threat to carry things to Parliament. The working man to-day is full of economic heresies. He seems to think he can ask Parliament to pay wages out of funds which exist in his imagination, as though Parliament could do anything and everything. This nonsense is the result of preaching to the so-called working man as though he were a wonderful creature, all virtue and with no vices, and he has been patted on the back by M.P.'s and the like until he has come to think he is all that fancy paints him. It is all this which has led up to the conduct of the men in respect of restriction of output and general insubordination to the truth and to the principles of business morality. Their line of procedure has been followed for long past much as a train may run safely over a line of rails for a long time until it reaches a junction. In the case of the engineers they have run their train full of economic heresies until it has intersected that of foreign competition and the result we have seen. Others have seen the convergence of the lines and the advancing trains. Mr. Barnes and his friends have contrived to time the trains to arrive very much together at the point where further concessions to the men brought matters in England to the wrong side of the line for foreign competition. The strike is, however, now a thing of the past, and it is hardly likely that another can be started on the same false and mistaken issues. It will be long before such a strike can be financially possible, and in the interim educational influences have a chance to operate on men and on masters. For the moment the beaten and disappointed leaders are talking frothily about the next attempt. For the sake of the men, it is to be hoped by then that they will have obtained more intelligent leaders.

As the shops were opened on the first Monday in February, it was at first decided by the employers to take on only one-fourth of the number of men necessary to fill vacancies. This was done in order to give all shops an equal chance to obtain hands. But so many shops had already so large a complement of free labour, that it was seen there would not be places enough to go round, and word was given to take on all there was room for. This still left a lot of men out of work, for many shops were short of orders, none having been sought during the strike, and it would therefore be some time before all the strikers could be taken on. So far as we can learn, the men themselves have gone back to work in a fairly agreeable spirit, the fact being that they see plainly enough they have been following a bad lead. The employers also, we are glad to hear, are doing all they can to smooth matters and are not injudiciously flaunting a flag of victory before their late opponents. Only in one or two American papers, such as the *Western Electrician*, do we find the termination of the strike viewed with spiteful ill-nature. This journal is a sample of that fortunately diminishing section of the American people, which hopes and prays for overwhelming disaster to overtake the British nation—America's best customer. We do not think much weight need be attached to such evidently biassed statements as the writer is so evidently uninformed, but he lays all the blame on the neglect of the employers to provide improved tools—a clear proof that he knows nothing of the machine question and of restriction of output which underlay the whole dispute. But while we may excuse the western editor, what are we to say of such a man as Sir John Gorst at the dinner of the United Club which had before it the question of the relation of capital and labour. He spoke on the question in an exceedingly unpractical manner, assuming that it were better to leave work alone than to attempt it at the cost of reduced wages. This way of looking at things assumes at the outset that both men and masters are doing their best, and cannot improve so as to afford a so-called living wage. It also assumes that when articles are made in this country for which only low wages are practicable, such low wages are paid to people who, if not compelled by the employers to work for poor wages, would be working at something else for good wages. The idea is absurd. No man is compelled to work for less than he can get elsewhere, and the inference is that in badly paid trades the work is unpopular, and is only taken up by those who otherwise would be idle. But it is not by any means employers who are the cause of low wages in certain employments. It is due to the workers themselves, who rush into badly paid work rather than take up well paid work which they can have for the asking. It is customary, for example, to cry shame on the management of a certain bread company which pays huge dividends out of purveying very ordinary provisions, and is said to pay poor wages. The sole reason is that the women who crowd the doors of the company for employment and accept poor pay for long hours, have open to them far more respectable and well paid work in domestic service, which is not fashionable among this class of women. Yet philanthropists so called can always be found to condemn the wrong person, and there are those who in the recent strike condemn the employers because they have refused simply to pay away in wages more than they have made in profits, a process that to anyone but a rabid philanthropist cannot long continue. When Sir John Gorst assumes it may be necessary to throw up the sponge, he is indeed a pessimist. In the first place he does not even present the hope of doing better; in the second, as an alternative to small profits and wages, he has nothing to offer. When it is remembered that he was speaking in connection with the engineering business, of which shipbuilding, our national pet industry, is a part, are we to conclude that England had better go out of business at once? Sir John spoke just as if he had been of opinion that the recent strike was a protest by the men against a starvation reduction in wages. So at least his reported speech reads, and he ought to have known better. The public at large did know better, or very soon learned the facts, and the strike was really crushed before it had existed a fortnight, and everyone saw this except the men themselves, and even they saw it sooner than their leaders, who tried to buoy up their followers by extolling the German and American subscriptions.

We hardly think that English workmen will be such fools to be caught by the high sounding "brotherhood of labour" business in the future. During the whole strike for eight hours, the selfish German workmen did not, so far as we can learn, make even the shadow of a demand for the reduction of their own 12 hours' day, which would have assisted their dear English bulldogs. They simply subscribed a few pfennig each, and raked in the wages for the work the English would not do, and unless the English workmen will study these things for themselves, and not put their lives into the hands of the first stump orator who gets up and froths, they must expect foreigners to treat them as fools.

TESTS OF THE SYNCHRONOGRAPH ON THE TELEGRAPH LINES OF THE BRITISH GOVERNMENT.*

By ALBERT CUSHING CREHORE and GEORGE OWEN SQUIER.

In April, 1897, a paper was read before the American Institute of Electrical Engineers, describing the general principles of the synchronograph and the experiments at that time completed in developing it.† Since then opportunity has been presented to make trials on actual lines of considerable length and having different distributed capacities. The tests were made over loops of varying lengths from the General Post Office, London, where both transmitters and receivers were located.

The apparatus available for experiment comprised a high frequency alternator, giving practically harmonic waves from 50 to 720 complete waves per second; actual telegraph lines with values of K R varying from 0 to 261,000 and resistance varying from 0 to 10,000 ohms; an artificial submarine cable representing within 1 per cent. of accuracy an actual cable of 180 knots in length, and also the latest types of Wheatstone transmitters and receivers, with adjustable condensers, &c.

The longest loop tried was 1,097 miles, from London to Glasgow, Aberdeen, Edinburgh, and return to London by a different pole line. This contained some iron wire and also 48 miles of underground cable, and a total value of K R equal to 261,000.

* Abstract of a report to the Postmaster-General of the United States, read before the Franklin Institute, January 19th, 1898, and published in the *Electrical World*.

† See ELECTRICAL REVIEW, May 7th, 1897.

It was found in the course of trials with the different apparatus that it was possible to operate the Wheatstone receiver without alteration by the synchronograph transmitter, and a test was made over the longest line to compare the efficiency of the two transmitters when operating the same receiver under identical line conditions. The surprising result was discovered that the synchronograph could operate the Wheatstone receiver approximately three times as fast as the Wheatstone transmitter on any line, provided the mechanical limit of the receiver is not already reached. The Wheatstone system operated from London to Aberdeen ordinarily employs two automatic repeaters to increase the speed. Without any repeaters the synchronograph operated the Wheatstone receiver over this line practically up to its mechanical limit. By the synchronograph method of transmission it thus becomes possible to operate Wheatstone receivers at the present speeds without repeaters anywhere in the British Islands.

One of the most important results of the trials to be described has been to emphasise the probability that the sine wave possesses superiority over other forms of wave for any speed, slow or fast.

The messages are prepared for the Wheatstone transmitter by perforating paper tape with two rows of holes at the proper intervals to secure correct signals, one row on each side. In the centre, between these two rows of holes, runs an uninterrupted series of smaller holes, which serves to feed the tape regularly through the transmitter.

A characteristic of the transmitter is the fact that the contact for the electrical circuits is not made through the holes in the paper, as in some transmitters, but by small steel rods, which pass through the holes in the paper, contacts are made and broken in another part of the apparatus by means of levers. Only the positive currents cause the receiver to make a mark. A dot, together with the accompanying space corresponds to a complete wave of current. A dash with its following space occupies twice the time of a dot with its space, and corresponds to the time of two complete waves, although in reality it is a single wave with the positive portion three times as long as the negative, and thus the mark for a dash is about equal to three dots.

The chief characteristics to be noted are that the waves of impressed E.M.F. are square-topped, and those for a dash are longer than for a dot.

An essential part of the receiver is a polarised relay consisting of a permanent magnet and an electro-magnet. The armature of the receiver, to which the recording wheel is attached, is moved in one direction for a direct current and in the opposite direction for a reversed current. A small recording wheel is kept moistened with ink, and every positive current drives it against the paper, while a negative one raises it from the paper. The paper tape is driven forward by clockwork, and thus a series of marks is made upon the tape corresponding to the positive portions of any set of current waves.

In practice it is found that, when connected directly to the line and the return, and operated by the transmitter, the speed obtainable over most lines can be increased by the use of condensers shunted by non-inductive resistances and inserted in the main line. Common values of the resistance and capacity are about 8,000 ohms and 10 to 20 microfarads, which would vary according to the line.

The details of the experimental transmitter used in the synchronograph experiments were practically the same as those employed in the original experiments, and described in the first paper to which reference has been made. The messages were prepared by fastening strips of paper upon the metal surface of a large wheel geared directly to the shaft of the alternator as there described.

As it was desired to make tests over a considerable range of frequencies, the small Pupin alternator used in the first experiments was again utilised for these trials. The alternator was driven by a 1 H.P. Lundell motor, supplied from 100-volt constant potential mains, and a storage battery was available for the excitation of the rotating field of the generator. Since the generator is, in fact, four alternators of 18, 22, 26 and 30 poles respectively, and the motor could be run regularly at very slow speeds as well as high, this combination with a field excitation, which could be varied at will, permitted a wide range of frequencies at any desired voltage. Transformers were used when desired. For the most rapid speeds the chemical receiver, using the formula of Delany, was employed with the synchronograph. The paper was prepared and used in the form of sheets instead of tape.

The lines first used in the tests of August 8th ran from London *vid* Leeds to Newcastle-on-Tyne, and return to London *vid* York.

With no earth, messages were received with ease at a frequency of 652 cycles, or 1,304 alternations per second. This frequency was limited by the fact that the greatest number of poles to the generator was 30, and the number of revolutions to produce this frequency was 2,608, beyond which it was not then thought advisable to go for fear of injuring the machine.

With earth and a total value of K R equal to 81,518, a frequency of 165 cycles, or 330 alternations per second was reached.

To obtain a longer line with a greater value of K R, a second loop was made up from London *vid* Leeds to Glasgow, and return *vid* Edinburgh, Newcastle-on-Tyne, and York to London.

As before through this line without earth, K R being 31,771, a current was sent having a frequency as high as safety to the alternator permitted, viz., 652 complete waves per second, and no limit of speed due to line damping was reached, the messages being received with perfect clearness. With earth and K R = 127,082, no records were received at all on this date on account of not having at hand a suitable transformer to produce high enough potential at the slow speed of the alternator necessary. Before the next trials were made a suitable transformer was available to deal with a value of K R much larger than the above.

To test the fact that the messages were actually passing through Glasgow, and that the records were not being caused by leakage currents across the line at some point, the circuit was broken by the operator at Glasgow at a certain time, and restored five minutes later. Before and after the line was so broken the messages were transmitted readily, while during the time it was broken not the slightest record could be obtained.

An instructive experiment, illustrating forcibly the influence of increase of distributed capacity upon aerial wires, was that of suddenly plugging in and out the earth connection, thereby practically changing the capacity of the line four-fold, when at the instant the earth was connected the motor would slow down and labour under the increased load.

On Thursday, August 12th, it was decided to try the synchronograph with the Wheatstone receiver, which was at hand in the same room. This was done, and without any alteration of the receiver whatever it responded readily to each wave of current from the alternator. Messages were then correctly transmitted and received. This was done by two different methods. First, the messages were interpreted by the portions of current omitted, as described in the former paper, the omission of a single mark denoting a dot and two marks a dash, the marks themselves meaning spaces. Second, the presence of the marks was used for dots and dashes, and one mark denoted a dot, while two or three consecutive marks denoted a dash. The marks are all regularly spaced, and the eye experiences no difficulty in reading the dash, even though it is made up of two or three separate consecutive marks instead of a single long mark, since the length of the dash is of more moment than the continuity of the mark.

These preliminary tests developed the fact that messages could be received by the Wheatstone receiver in the laboratory faster with the synchronograph than with the regular Wheatstone transmitter. When this discovery was made the engineer-in-chief desired to make a more extensive series of experiments and try the synchronograph with the Wheatstone receiver over actual lines having a value of K R sufficient to reduce the speeds. As the Wheatstone receiver was to be used with the alternating current, the first thing wanted was a knowledge of its constants. The inductance of the instrument measured by the impedance method was found to be ·875 henry for a single coil and 3·46 henrys for the coils in series. When the coils were connected so as to give opposing magnetic effects the measurements gave an inductance of ·187 henry. The two coils of the receiver are wound together, the two wires being wound as one upon the spools in such close proximity that the mutual induction between the coils is at its maximum, and is nearly equal to the inductance of each coil. In such a case the inductance of the two coils in series should equal four times that of a single coil if there were no magnetic leakage, and when connected in opposition the inductance would vanish. This agrees approximately with the measurements when allowance is made for small magnetic leakage.

When the receiver coils are connected in parallel the inductance is practically the same as that of a single coil, since the two coils are like a single one having larger wire, the number of turns being identical.

Thus, with a frequency of 650 cycles per second, the reactance is many times larger than the resistance of the coil. In either case of a series or parallel connection of the coils it is 22·75 times as much.

When the receiver is used with reversing currents, such as are employed in the Wheatstone system, or with alternating currents, the impedance is the important element, and the value of the resistance makes very little difference, provided it bears so small a ratio to the impedance.*

When the synchronograph was used with the Wheatstone receiver the resistance with its shunted condenser, described above, was removed from the line, and the condenser shunted directly around the receiver. The receiver and condenser thus form a resonant circuit, and by properly choosing the condenser it is possible to increase the receiver current materially, making it larger than the line current. This is the benefit of using a condenser, but the capacity for the best effect should vary with the frequency of alternation. By knowing the inductance of the receiver and the frequency, the condenser capacity can be readily calculated. The value of the capacity for any frequency is not very critical; that is, a condenser will improve the working for a considerable range of speed.

With lines having a low value of K R, the speed of the Wheatstone system is limited to about 600 words per minute, as this is found to be very near to the mechanical limit of operation of the receiver, due to the inertia of the moving parts, the spattering of ink or other causes.

A copper aerial line having K R equal to about 30,000 will reduce the Wheatstone speed to about 400 words a minute; and when a line exceeds this it is customary to insert an automatic repeater, by which the speed is maintained over longer distances. Speeds of 400 words a minute are regularly maintained in England in commercial working, while the limit of the commercial working in the United States is considerably lower, about 200 words per minute.

The speed of the synchronograph transmitter and a chemical receiver would be greater than that with the Wheatstone receiver, because of the shorter code permissible with this receiver. There would then be no limit at 600 words due to the mechanical construction, so that the value would run up into thousands of words per minute. The speed cannot be given, as the experiments have not yet established the law of speeds for this combination of instruments.

Opportunity was presented for tests of this method of transmitting signals over the artificial cable belonging to the British

* With the receiver in circuit with the main line the inductance of the former should be considered in comparison with the resistance of the whole circuit, and its combination vectorially therewith affects the latter very slightly.—Editor.

Post Office, and making direct comparisons of the alternating current method with the present Wheatstone system over the same cable. This cable, which represents within 1 per cent. the real cable used from England to the Continent, to Ireland, the Channel Islands, &c., is made in 60 sections of 3 knots each, making a total of 180 knots or 207·5 miles. Each section has K equal to 1 microfarad and R = 33 ohms, making total K = 60 microfarads and total R = 33 × 60 = 1,980 ohms, and total K R = 118,800. The cable is of the type in which the distributed capacity is obtained by condensers placed at regular intervals along its length.

Through this cable, with a voltage of 110, messages were sent at a frequency of 93·6 periods, or 187·2 alternations, per second, using the synchronograph and the chemical receiver. The next experiment was with the Wheatstone system transmitter and receiver, using 100 volts constant potential, and a speed of 120 words per minute, equivalent to 72 complete waves per second, was reached by the post office officials.

From a long experience in the British service the basis which is there used to calculate the number of words per minute in terms of complete cycles of current by the Wheatstone system is 36 complete cycles = one word, or ·6 of a complete cycle of current per second equals one word per minute. This basis has therefore been used throughout in calculating the comparative speeds, using the synchronograph with the Wheatstone receiver, so that the comparative results given are independent of the length adopted for a dash, or indeed of the particular code employed.

The cables from England to the Continent are not at present operated by the Wheatstone system, although by so doing the speed would undoubtedly be increased; but the Hughes system, by a present international agreement, is employed. By the Hughes system the messages are printed on a tape, which can be mounted on a blank and delivered.

With the experience already gained and the constants of the Wheatstone receiver measured, a wider range of experiments was planned, to include tests over each line for speed as follows:

(1) Wheatstone transmitter and receiver.
(2) Synchronograph and Wheatstone receiver.
(3) Synchronograph and chemical receiver.

Two other lines were made up, which, being used both with and without earth, were equivalent to four separate lines. One of these was a loop from London *viâ* York and Leeds to London with values R = 2,783, K = 11·95, K R = 33, 257, and K R with no earth = 8,314.

(To be continued.)

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS.—1898.

[*Compiled expressly for this journal by* **W. P. Thompson & Co.**, *Electrical Patent Agents, 322, High Holborn, London, W.C., to whom all inquiries should be addressed.*]

18,718A. "Improvements in, and relating to, electric railways and tramcars." S. H. Short. Dated February 3rd. (Date claimed under Patents Rule 19, August 12th, 1897.) (*Complete.*)

2,433. "An improved system of adapters, to adapt all existing fittings for electric lighting to armoured, sheathed, or other concentric cables." H. F. Phillips. Dated January 31st.

2,455. "Improvements in electric contacts suitable for railway signalling and other purposes, and apparatus for use in combination therewith." R. Burn and A. C. Brown. Dated January 31st.

2,479. "Improvements in terminals for electrical connections, especially adapted to incandescence lampholders." G. Byng and H. Bevis. Dated January 31st.

2,485. "An improvement in electric arc lamps." C. Oliver. Dated January 31st.

2,487. "Improvements in apparatus for distributing electricity." H. Pengelly. Dated January 31st.

2,495. "Improved method of insulating electric apparatus and conductors." J. L Berthet, M. Mollard and L. Dulac. Dated January 31st. (Date applied for under Patents, &c., Act, 1883, Sec. 103, July 2nd, 1897, being date of application in France.)

2,522. "An improved electrical striking mechanism for bells." A. Eckstein and H. J. Coates. Dated February 1st.

2,538. "Improvements in, or in connection with, the electrical propulsion of road vehicles." G. Wilkinson and L. W. Holmes. Dated February 1st.

2,551. "An improved combined electrical dynamo and motor." T. Cooper. Dated February 1st.

2,571. "Improvements in electro-dynamic elements." C. Vallot and E. Pauze. Dated February 1st.

2,572. "Improved paper carriers and spacing mechanism applicable for use on typewriters or linotype machines, telegraphic, printing, and recording instruments." A. G. O'Farrell, J. E. Schumacher and W. R. Makins. Dated February 1st.

2,580. "Improvements in electric lighting media." H. A. Kent. Dated February 1st.

2,584. "Improvements in the manufacture of electric glow lamps." W. L. Wise. (C. Pieper, Germany.) Dated February 1st.

2,591. "An improvement in electric plating." F. T. Harris. Dated February 1st.

2,604. "Improvements in systems and apparatus for electric time control." W. P. Thompson. (The Self-Winding Clock Company, United States.) Dated February 1st.

2,618. "Improvements in supports, chiefly designed for electric incandescent lamps." L. Weldon. Dated February 1st. (*Complete.*)

2,669. "Improvements in electrical cut-outs." W. McGeoch' Jun. Dated February 2nd.

2,670. "Improvements in electrical keyholder and analogous switches." W. McGeoch, Jun. Dated February 2nd.

2,684. "Improvements in apparatus for the electro-deposition of metals." F. Fisher, Benjamin John Round, Benjamin James Round, and A. Round. Dated February 2nd.

2,723. "Improvements in electric arc lamps." H. Crudgington. Dated February 2nd.

2,734. "Improvements in, or relating to, electric incandescent lamps." A. J. Boult. (C. Duvivier, Belgium.) Dated February 2nd.

2,735. "Improvements in, or relating to, dynamo machines and electric motors." M. H. C. Shann and R. E. C. Shann. Dated February 2nd.

2,761. "Improvements in high tension electric switches." E. W. Cowan and A. Still. Dated February 3rd.

2,770. "Improvements in holders for incandescent electric lamps." G. Jaeger and H. Bender. Dated February 3rd. (*Complete.*)

2,784. "Improvements in electric switches." O. C. Immisch. Dated February 3rd.

2,788. "Improvements in electric incandescent lamps." R. B. Roxby. Dated February 3rd.

2,805. "Improvements in electrical tumbler switches." H. Crudgington. Dated February 3rd.

2,814. "A new or improved manufacture of insulated wire for electrical purposes generally." J. F. Brennan. Dated February 3rd.

2,819. "Improvements in electric cigar lighters." W. F. Kessler. Dated February 3rd.

2,849. "Improvements in electric switches." A. E. Tanner and F. A. C. Leigh. Dated February 4th.

2,871. "Improvements in electric furnaces." W. H. Graham. Dated February 4th.

2,876. "Improvements in electric lamp bulbs." J. Atherton and C. M. Downie. Dated February 4th.

2,891. "Improved announcing and recording apparatus applicable to telephones." F. B. Grunert. Dated February 4th. (*Complete.*)

2,904. "Improvements in electric heating and melting, specially applicable to the metal pots of linotype machines and the like." The Linotype Company, Limited, J. Place and M. Barr. Dated February 4th.

2,967. "Improvements in electro-depositing anodes." H. L. Haas. Dated February 5th. (*Complete.*)

2,968. "Improvements in electric switches." R Belfield. (G. Wright, United States.) Dated February 5th.

2,991. "Improved double arc lamp." W. Mathiesen. Dated February 5th. (*Complete.*)

2,998. "Improvements in and relating to the decomposition of alkaline salts by electrolysis and in apparatus therefor." J. Greenwood. Dated February 5th.

2,999. "Improvements in transmitters of Morse telegraphic apparatus for continuous and alternating currents." C. Rossi and P. Forcieri. Dated February 5th. (*Complete.*)

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

[*Copies of any of these Specifications may be obtained of* **Messrs. W. P. Thompson & Co., 322, High Holborn, W.C.**, *price, post free,* **9d.** *(in stamps).*]

1896.

21,236. "An electric regulator." W. Emmott. Dated September 25th, 1896. The brightness of lamps or the strength of a current through a circuit is controlled by means of a self-induction coil. The coil may be in sections and the current may be sent direct or through one or more of the sections by means of a suitable switch; or the core may be movable within or in relation to the coil by means of a switch lever.

21,293. "Improvements in electrical door bolts." S. F. Page. Dated September 25th, 1896 The bolt is arranged to be shot or withdrawn or both shot and withdrawn by an electro-magnet. A bolt is shown which is shot by a spring and withdrawn by a magnet, the circuit of which may be closed by a person in bed, for instance. A metallic rod on the back of the bolt operates an alarm when the bolt is withdrawn. Two electro-magnets may be arranged around the bolt, one for shooting and the other for withdrawing it.